



Trichocereus pallarensis FR676
Grown in California from Ritter's seeds:
purchased from Hildegard Winter in 1961.

Trout's Notes on
the Cultivation & Propagation of Cacti



Trichocereus pachanoi
from Matucana, Peru



Encephalocarpus
strobiliformis

Trout's Notes on The Cultivation & Propagation of Cacti

was excerpted as Chapter 7 from

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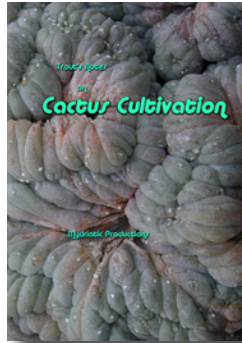
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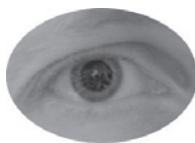
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Trichocereus scopulicola



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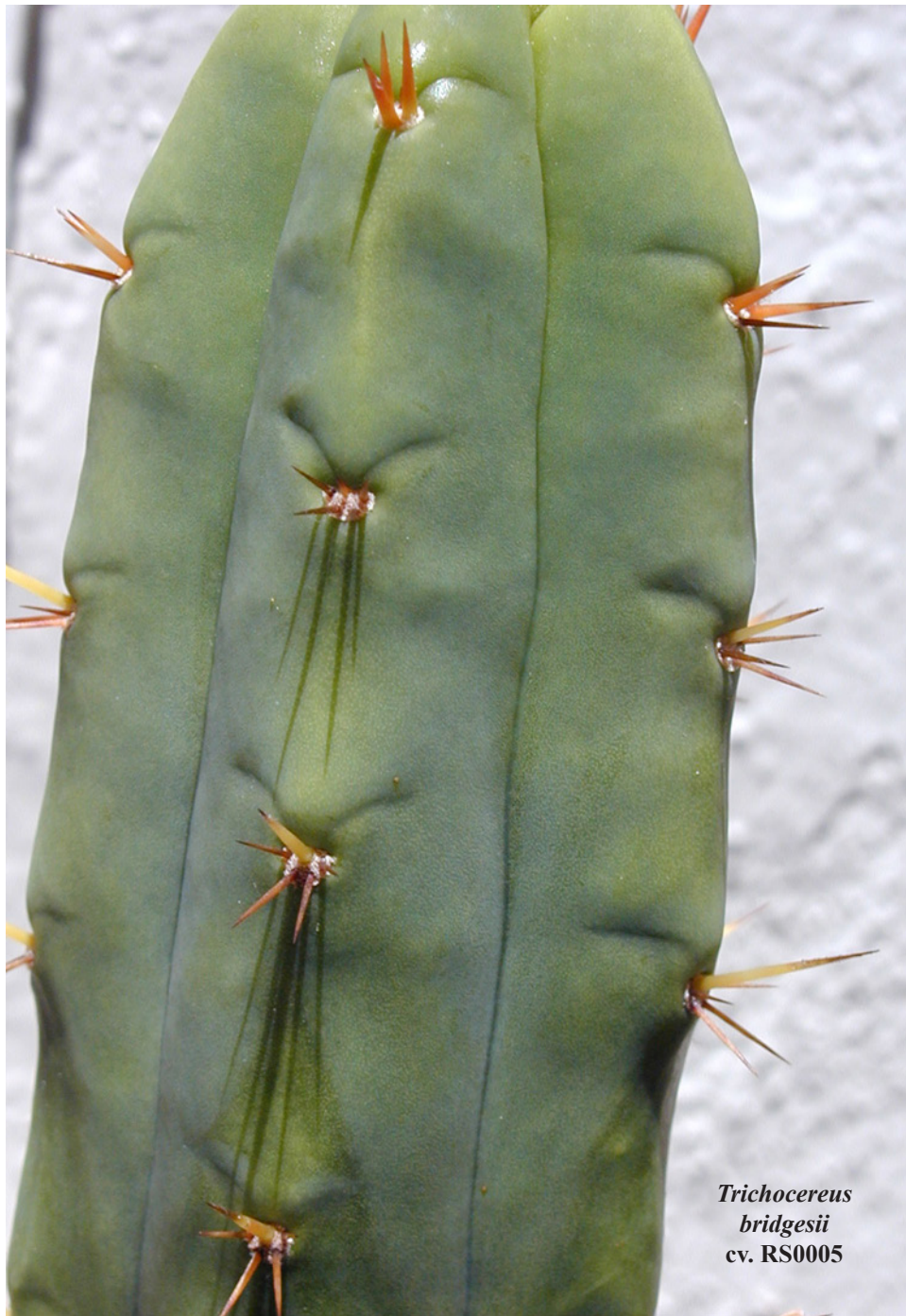


Trichocereus bridgesii
in Australia

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*Trichocereus
bridgesii
cv. RS0005*



Borzicactus sp.
both images



Growing cacti from seed

Cacti are easy to grow from seed if one is patient.

Key points: when very young, cacti do not usually like full sun and cannot take either being soaked or drying out completely. A fluorescent plant light about a foot to 18 inches from the plants is good until one can gradually harden them off. Some may like an 8" distance better.

Plant the seeds assuming you will not transplant them for a while. Leave up to an inch between each seed if germination rates are good. (Columnar *Trichocereus* species will do better if they are more crowded so they can give each other some support while young.)

When they first start they will look like a little blob of green flesh with two small horns [Note 1] (primitive leaves) in the case of Pedro and *Trichocereus peruvianus*, or like a small ball with a tuft of sparse white spines at the top in the case of peyote. Cacti start out with the first fully formed plant emerging from the seedling by forming out of the heart of the clump of spines at the center top. This small point of growth is called the apical meristem and all initial growth comes from it. It is beautiful to watch.



Temperatures are critical. Best success will be had if temperatures are kept in the 70 to 85 degree range. With a minimum of 68° for the absolute low and 90° as a recommended top temperature (Note: some such as *Trichocereus macrogonus* seem to germinate and grow best under hotter conditions). Chilling encourages damping off (grayish tufts that are death for emerging seedlings.). The normal commercial approach to prevent this is to use Benomyl™ on the seedlings. Chinosol™ (Potassium hydroxy-quinoline sulfate [Note 2] in the concentration of one teaspoon per 1-2 pints) is harder to find but is safer to use than Benomyl™. Chinosol forms a strong smelling yellow liquid when mixed with water. It must be used immediately when mixed as it does not keep. The dry powder keeps well indefinitely. (Both of these things are true of Benomyl™ as well.)

An ideal set up would have the temperature levels controlled and misters set to automatically kick on intermittently for a few seconds; keeping everything damp but not wet. The actual time of misting will vary depending upon many factors. Most are easy to adjust for your own needs. Many people completely enclose the containers they have the seeds in. This approach will work well but, unless closely watched, has a tendency to grow fungus and algae which will destroy seedlings. Another approach, if you don't have a misting system, is to provide misting with a small hand held spray bottle several times a day. It is more labor intensive but can be successfully employed even for thousands of seedlings.

Plant them in groups in 3 or 4 inch deep trays and keep only one species in a tray. The trays need to have lots of large drain holes or else slots, close to the ground, along the bottom edge. Plastic trays with sawed grooves (not going up the side more than ½ inch), and more holes in the center of the bottom, make durable seed flats if not of photosensitive material. Small pots will also work provided they are not planted too densely. Let them grow where they sprout until physically crowded or actually touching each other before transplanting.

You will have much better success if you plan on not transplanting for at least the first year or more. The only other time transplanting is a potentially good idea is right after germination when the seedlings can be pricked out of the soil with a sharp instrument. This must be done before the fragile hairlike first root has grown any length. This requires some practice and a steady hand. It works well for the experienced but may not be a good idea for the novice to try on rare cactus. Even the smallest bit of damage to the fine white hair of the root will kill the plant or render it sickly and doomed to die young. Some people do it quite well, rapidly and with little loss. See page 7 for some helpful seedling pricking tools.



Astrophytum seedlings as sown

If planting outdoors, use large gravel as a top dressing and allow the seeds to come up in the cracks. Some type of protection from direct sun and rain exposure is crucial to success with this method. Regular cactus mix should be used for this approach.

The seedling soil mix should be moisture holding and used only for the first year or so (whenever they take their true adult form). We usually use a quarter vermiculite but plan to start replacing this with coir this year. Small grained but coarse sand (sharp sand) that has been washed and screened to remove very fine particles should form 20 % to 40 % of the mix. Pumice granules are a good minor additive as are granite sands with fine dust screened (wear an approved dust mask) or washed out. Perlite works well with larger plants but it floats to the top of the soil too readily and tends to displace or injure young seedlings. For the rest of the mix, use compost, (and/or oak leaf mold and/or sedge peat) and a little thoroughly composted manure, or if necessary, a good potting soil or seedling mix. (Peat based mixes will work but losses will be noticeably lower if peat moss is not used. Sedge peat or neutral peat is acceptable; coir (ground coconut hulls) is even better if it is washed prior to use.) Using a larger mesh size (around 1/4" or less); screen it and remove all large particles. All organic material must be thoroughly composted.

The tray should be filled with soil; preferably almost dry, slightly damp is acceptable but wet is not. It should have about half to less than an inch of lip left on it, the surface being smoothed out all the way to the edges and not packed down.

For fine seeded cactus, use a screen, household metal sieve or strainer to dust and top coat the soil with a thin, even layer of finely pulverized potting soil, tiny gravel or coarse sand as the top layer.

Seedlings in left column from left to right:
Peniocereus greggii, *Coryphantha tuberculosa*,
Lophophora williamsii, *Coryphantha macromeris*.

In the case of water sensitive types, use screened and washed sand for the top layer. Using only the sand that DOESN'T go through a fine screen; obviously you will want a slightly larger mesh size to spread it. Be certain the mix in the strainer is dry before spreading.

Use a small ruler or a smooth edged small board (a piece of 1x2 is excellent as is flat trim stock) to smooth and even out any high or uneven spots. It is OK if a small bit of excess is at the edges (less than a couple millimeters).

Dust the seeds as widely and evenly across the surface as you can, using dry fingers or gently tapping the edge of the seed pack with one corner open. Try to avoid sowing near the edges. Invariably they will end up in the narrow separation that forms between soil and container and take advantage of their natural tendency to grow into cracks. The plants thus produced will be somewhat flattened on one side as they grow. This can be a problem aesthetically in smaller plants.

After scattering the seeds finely across the surface of the soil, set the tray gently in a larger pan or tray with about one inch of water in it (if more is needed add it only to the bottom tray). Watch just until the top surface of the soil gets dark most of the way across the surface and collapses slightly as the water soaks into the soil and wicks up to the surface. You only want it to get wet not soaked.

Immediately take it out of the pan of water so that it does not get water logged and cover with a flat piece of plastic or plastic wrap to keep moisture in. [Watering can also be done by spraying or misting the soil until wet. Misting needs will be higher if not bottom watering]

Remove the plastic wrap at least partially every day long enough to allow some air circulation. The easiest time to do this is when watering or misting. Neither should be needed the first several days. Be certain that nothing ever dries out or gets soaked.

Once germination begins remove the cover entirely. Cactus require adequate ventilation for good health whether seedling or adult. Mist the seedlings every day. Do not allow the surface of the soil to get dry unless for brief periods. Plants should be misted and/or bottom watered until young adulthood.

Some people successfully grow small numbers of cacti by placing newly planted small pots in a baggie and closing it to make a miniature greenhouse. These are left closed until germination begins. They normally use a fungicide in the initial watering.

I have also witnessed success using hinged top clear plastic boxes (and a heating mat) for the germination chamber but obviously great care must be taken to not overwater due to lack of drainage.

(If planting in the open outdoors drop the seeds into cracks between half inch or larger gravel and add enough soil to cover them as deep as the seeds are wide.

The rocks will provide partial shade for the first few weeks or months of life. Losses will always be high due to predation and other problems when planting in the open. However those plants which do live will be strong and hardy. A good adage for wild plants dropping seed for propagation is "A thousand seeds for a seedling. A hundred seedlings for a plant." This is not far from realistic figures for seeds planted by their parents.

Success rates are much higher in cultivation. Rates of 60 to 80 % germination and about the same percentage of those seedlings surviving till adulthood can be observed. Sometimes the rates are higher, as is often seen in *Coryphantha macromeris*, but usually they are lower. Normally to get 10 or 15 adult plants it is common to have to plant 100 seeds. Rare or tricky plants may yield even less. Sometimes only a couple plants per hundred seeds make it to adulthood. Usually the culprit behind low returns is unsuitable environmental conditions like cold, or draft (a major killer of many indoor cactus during winter), improper soil, or excess, or deficient moisture. The latter is also a common winter killer. (Cacti need to be dry in winter but heated air may require that they be given small amounts of water throughout the course of the winter if kept warm.) Root maggots are also a common winter killer.



Within a week to several months, depending on species, a flush of seedlings will start. All will have markedly staggered germination over the course of the first year, a handful the second year and occasional ones over the course of the next 5 years. Flats of soil with cactus seeds should be kept at least three years. Sometimes second year flushes are substantial.

If germination does not occur within two weeks, allow soil to dry thoroughly. Alternate periods of 10 to 14 days of damp with 5 to 7 days of dryness. Keep a sharp eye out for germinating seedlings during the dry periods. Misting will need to resume immediately as soon as any green is visible. Some cacti need periods of dryness to stimulate germination. None will tolerate ungerminated seeds remaining wet for weeks on end.

If germinating hard-to-start water sensitive cacti and finding no germination; place the flat in hot direct sun exposure for a week or more. Mist it occasionally and lightly. Then remove from direct sun and repeat one cycle of wetting. Repeating this a few times can coax some difficult to germinate seeds. See more observations under *Coloradoa* below.

Another helpful tip on very tricky cactus species, whether as seeds or adult plants, is to use local native soil as the organic portion of the starting mix. There is considerable potential for introducing disease and soilborne pests. Either segregate from the rest of the plants or steam sterilize soil before use. [Stratification by freezing may help some species.]

Astrophytum seedlings replanted

Chapter 7: propagation from seed

Larger seeded cacti are simple. Everything is the same except that they should be individually placed up to half an inch or more apart. Instead of adding a final layer of fine mix to the surface of the flat, plant the seeds directly on an even surface of soil. Then cover them with several times their diameter in depth of finely screened soil or the sand and manure mix described above. Initially covering with plastic for inducing germination is very helpful but not as essential as with small seeds.

One very successful grower uses coarse sandblasting grit as the top layer, allowing small seeds to fall between the grains and using it to cover larger seeds. They recommend about a 3 mm. layer for most seeds and slightly more for very large ones.

There is still the same necessity of keeping everything just moist but never soaked by misting. This can be done with a hand mister for small numbers if a person is reliable enough to be consistent. Twice a day is a minimum and bottom watering must replace all top watering that might dislodge beginning seedlings.

When young the seedling is like a small blob of flesh with a single fine white hair like root. If anything happens to hurt or damage the root at this stage the cactus will not survive. They might take some time to die but death is almost certain. It is crucial for them to be undisturbed for at least the first year to 18 months. Three years might be preferable in the case of small globular or very arid tolerant forms of cacti. If this is the case plan ahead by using an adult cactus mix for the seed flat (or, if available, native soil [Note 3] with drainage promoting ingredients incorporated to prevent caking or compaction). Make sure that there is something like well composted manure or shredded and screened vermiculite incorporated into the very top final layer to hold in moisture for germination. Avoid peat (unless sedge peat) **like the plague** for these types of plants. (Plants such as *Ariocarpus*, *Coryphanthas*, *Epithelanthas*, *Pediocacti*, *Sclerocacti*, *Turbinicarpus*, etc...)

At this stage sun must be avoided. Placing the flats under fluorescent plant lights 12 to 18 inches above them, works very well. If any yellow, bronze or red seedlings are noticed cover the flat with a piece of white paper to cut the light down and gradually get them used to the higher levels over the course of the week, or raise the lights on that species by about 6-8 inches. This is a telltale sign of too much light. If the seedlings look washed out and pale they have too little light. Lower the lights closer to the flats by 6 to 8 inches.



Strombocactus disciformis seedlings

Only keep them enclosed until germination is obviously well underway. Misting them with a handheld mister several times a day is critical if a misting system is not available. (I know I'm repeating myself) Fog nozzles are indispensable for hand-watering larger plantings once the numbers get well into the thousands.

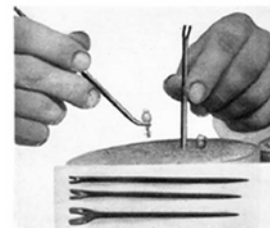
Somewhere around the first year or two, when the plant assumes its adult form, they can be gradually introduced to sun. Gradual is crucial. Shade cloth is very helpful.



Trichocereus peruvianus seedlings in a greenhouse showing clear signs of too much light & heat

Some cacti can handle full sun as seedlings but these are not the usual case. Even in those that can, many individuals will die. In some cases the seedlings are absurdly hardy. I have seen first year *Echinocactus texensis* ('Horse crippler') seedlings handle not only full sun but also freezing temperatures into the upper teens with absolutely no losses.

One commercial grower recommends that box-like frames with flat wooden walls be built around them with a top made of window screen. A couple feet over this they stretch sunscreen and they water or let rain fall on the sunscreen which they claim, combined with the screen on the lid of the box, breaks the water into droplets fine enough to take cactus from seeds to adulthood. They are one of the most successful growers I know of and offer many rare and desirable plants they have grown from seed. I haven't tried it but it has obviously worked for them. Most commercial grower's names have been deliberately omitted (unless in reference to a published article) as I do not know if they would want to be mentioned in conjunction with my general focus. I suspect they would not.



An advertisement of commercial seedling pricking tools; demonstrating their use and also illustrating three sizes.

Alfred KRAUSE (1933) *Kakteenkunde*. issue 1, ad facing page 20. "Geschäftliche Pikieren von Kakteensämlingen."

Cultivation of Peyote

In the following comments, I draw heavily from my past experiences in Texas growing peyote from seed and cuttings. When I began publishing, I decided to cease growing peyote due to the concern I might not be able to adequately protect the plants from destruction or loss (due to their illegality.) I would suggest this is worthy of reflection. Part of good plant stewardship is the ability to provide them with protection from harm of any sort.

Peyote is easy to grow and should be dealt with like any cactus, but will need agricultural limestone and/or gypsum and/or dolomite to be mixed into the soil to stimulate and allow flowering (about a heaping tablespoon per gallon of soil). I have had good results with also adding powdered limestone (use about 2/3 as much as gypsum) and using additional limestone rock to shade seedlings when young and when first being introduced to the wild. Careful placement will protect them from many things, including being stepped on, and they will simply push them out of the way when they get old. It also makes an attractive top layer for specimens.

Seeds should be treated like any other cactus, with the crucial addition that calcium minerals are incorporated into the soil mix. ANDERSON 1980 has found them to be slow growing; obtaining 15 mm. plants in 5 years of growth. He feels it will take around 15 years for them to reach maturity. I have found them to be somewhat faster in growth, albeit still slow, with plants approaching 2 inches by the age of 5. Usually reaching between 3/8 and 1/2 inch in the first year and will add about the same in diameter most years. Some individuals grow faster and some grow slower.

I suspect the difference between our experience and Anderson's is simply a reflection of our practice of regularly feeding the seedlings with low concentrations of fertilizer or else Anderson's plant weren't happy with their conditions of cultivation.

They do grow much more slowly in the wild than in cultivation. Anderson's figures may be more accurate for a wild plant.

They are very hardy plants tolerant of many conditions under which they will not thrive. They prefer partial or filtered sun and should be kept on the dry side and be fed several times a year with a high nitrogen (ammonium is preferable to nitrate) source for maximum health and sacramental potential.

In far west Texas, peyote grows in open rocky country, on slopes, ridges and hills. It also occurs in river valleys. Usually the soils are calcareous. It often grows in full sun or under plants such as *Larrea*, *Opuntias*, *Jatropha*, *Lechuguilla*, *Candelilla* and *Selaginella*. This form is thought by some to represent a different higher alkaloid variety or species; *L. echinata*. They are usually more grayish-green and far more cold hardy compared to the classical bluish green of the *L. williamsii* which grows in the 'peyote gardens' and into Mexico. (Not everyone agrees which plants *L. echinata* refers to.)

Seeds sold as *L. jourdaniana* usually simply represent a violet flowered form of *L. williamsii*. *L. fricii* is a red flowered Coahuilan species with a different alkaloid profile. *L. decipiens* probably refers to one of the forms [Note 4] that peyote can take. This name was discussed under *Lophophora* in an earlier chapter and variously means *L. williamsii* or *L. diffusa* depending on the supplier. This description was originally for plants showing pronounced tubercles and no ribs. This can be observed in *williamsii*, *diffusa* and *fricii*, sometimes Peyote can even have ribs swirling in a spiral.

I question whether those forms are really varietal or if the parents

were exceptional plants. They certainly all are beautiful. [Note 5]

These names are not always agreed on as horticultural designations among the people who sell them or even among taxonomists. Most are currently unaccepted, by most experts, as specific taxonomic nomenclature. More can be found in Chapter 4, under *Lophophora williamsii*.

Peyote tolerates a variety of soils, all seem to be a variation on calcium rich alluvial loams containing abundant silicate gravels and relatively low organic content. The organic content of the soil in five wild populations in Texas ranged from 5 to 16% in the soil tests performed by Cactus Conservation Institute.

Soils of occurrence, in the Chihuahuan Desert, ranged from pH 7.9 to 8.3 with more than 150 ppm calcium, at least 6 ppm magnesium, strong carbonates and no more than trace amounts of ammonia. Soil tested negative for iron, chlorine, sulfates, manganese and aluminum. (According to ANDERSON 1980) Soil in the Tamaulipan Thornscrub of the Peyote Gardens was found by the Cactus Conservation Institute to be pH 7.2 and 7.3 at two sites. Calcium was found to be 6% and 17% in those two samples. See more details in Chapter 4.

Peyote is tolerant of many soil types but does best in a well draining fairly rich mixture so long as it is not acidic. They normally occur in moderately poor soil, as can be evidenced by Anderson's soil analysis above, but they will grow faster and better if it is not. It is important that they have adequate calcium in their soil both for their overall health and for flowering to occur. OLMOS 1977 recommends that an additional 15% of coarse sand or grit be incorporated into their soil mixture.

Temperature tolerances range from 1.9 to 40.2° C [35-104° F] (ANDERSON 1980) This is a very good range to

ensure their survival but they can and frequently do survive greater extremes.

The growing of peyote should not be encouraged anywhere the winter extremes routinely get in the teens and occasionally go to single digits. They may even survive snow but with some loss from ruptured tissues. The plants go dark if frozen beyond their tolerances and if left will become unusable stinking slush. If harvested right away they are active and useful. Keep frozen until used.

Normally they are tolerant of cold and wet into the upper 20's without problems. Extended moisture in winter stresses them. Because of this, there was only short term success with colonization, experiencing major losses during 7 year winter extremes, causing an abandonment of attempts to populate Central Texas some years ago. There is an old man in Austin who has kept a lone, strictly ornamental, plant in a rock cactus garden with no winter protection, beyond a blanket in ice-storms, for well over 35 years (in 1997), which has included 6° F temperatures a few times.

Peyote growing in south Texas is occasionally found in open sun, but if one looks carefully there is often remnants of an older, long dead, plant that originally sheltered it. Normally they are found under plants that let the light through in patches of bright hot sun. Probably over half of everything visible at one given time is shade, but the sun coming through is hot and bright in patches that move, bathing the peyote in slowly shifting sunlight, as the sun moves across the sky.

Generally they grow under leafless plants or else those which have loose bipinnate leaves that droop and let filtered light come through as described. Even the most exposed *usually* have some shade for at least part of the day.



Grafted *Lophophora williamsii* in a private collection.



Notice it is loaded with ripe seeds? This is probably the single most valuable reason to graft any cactus species.



Lophophora williamsii echinata
0.5" diameter wild seedling
in Terrell County, Texas

These days, they most frequently grow in the middle of dense thorny scrub brush usually at the base of a thorny bush or thorny plant, surrounded by a tangled mass of more thorny plants; well protected from predators, including humans.

Peyote seedlings starting on open rocky slopes usually start in cracks between rocks or next to surface roots of plants where they have some protection from direct sun and water runoff when young.

Seedlings are favored by everything from rabbits to deer. If wild-crafting, the plants should be at least an inch and a half in diameter, if not larger, and well hardened before returning to the wild. By the third year the alkaloids are generally sufficient to discourage all but a few feeders. (Goats are said to totally destroy even adult peyote.)

A few animals will eat adult peyote. They will not eat much but they will occasionally become a nuisance by returning to eat more small portions. Mockingbirds, for instance, sometimes develop a taste for it but it is always as the lone bird taking one or two bites per visit. Squirrels also have been an occasional problem. Once again it is only the odd lone animal. When such animals eat adult peyote they usually only disfigure the plant, rather than kill it.

I once had my nursery invaded by rats when we were gone on a Winter holiday. There were two bites taken from the San Pedro, one small one from a monstrose *Trichocereus peruvianus*, none from the *Trichocereus validus* seedlings and absolute devastation of many thousands of seedlings and young plants of all types of cacti [Note 6].

Not so much as one peyote or seedling was touched. They ignored not only the *L. williamsii* but also the non-hallucinogenic *L. diffusa*.

They also destroyed much of my seed collection that was not in jars or refrigerated. When we returned, the rats were already gone. Numerous rat turds were found, consisting primarily of chili pequin hot pepper seeds strung together with the tiny red fishhook shaped spines of some *Mammillarias*.

I suspect the rats decided to leave of their own volition. Also that their departure was not a comfortable one. My nursery was never revisited by rats.



Lophophora williamsii

Grafting

Grafting is a useful technique for increasing numbers of plants, rapidly accelerating & amplifying seed production and also for enhancing the growth rate of normally slow growing species or enabling the growth of water sensitive species.

The part on top of a graft is called the *scion* and the (rooted) section on the bottom is termed the *stock*.

San Pedro is a common preferred stock because it is not only hardy and fast growing but it has few spines to get in the way of its grafted scion or the grafter's fingers.

For those who think propagation by grafting might be a slow or inefficient means of producing cactus; consider that the red *Gymnocalycium*s that are commonly available as ornamental cactus, and other chlorophyll deficient mutants that were developed later, arose from lone clone progenitors (one plant). In the case of the red *Gymnocalycium*, they all arose from a single chlorophyll deficient seedling that was noticed by a Japanese grower in 1941. These chlorophyll deficient mutants occasionally occur in any large enough plantings of seeds but normally the tiny plants soon die from lack of energy generation capabilities. In this case, they took the tiny red seedling and grafted it onto a larger cactus which was able to furnish its nutrient and vascular requirements.

The stocks had much faster growth rates so growth of the slower *Gymno* was substantially enhanced. These plants soon formed clumps which provided cuttings for another set of grafted cacti. Within two decades of dedicated plant propagation efforts, these became commercially available (around 1960). To give an idea of how successful of a program it was; in 1979, the Japan Cactus Trading Company was offering these cacti, already grafted, for slightly under one cent each, with a 1000 dollar US minimum order. They had a handful of different chlorophyll deficient grafted offerings for under 2 cents each in similar quantity.

The Lambs note that a normally slow growing *Oreocereus* which was grafted on top of a one meter tall *Cereus* formed three heads, each in excess of 60 cm., in only 6 years.

Grafted cactus grow excessively fast and full, often the grafts will take on an elongated or bloated appearance. However, they often form clumps even in normally solitary cactus. These pups can be removed for new grafting and hence new clumps or they can often be rooted to live on their own. Grafting is frequently done to enable the cultivation and propagation of very slow growing or rot prone cactus.

Grafting also stimulates flowering to occur at an earlier age and may be helpful in the establishment of plants cultivated for seed production purposes. Cacti grown for seed production should be fairly closely spaced and grouped as single species. Hand pollination is easy but doesn't seem to be necessary. It is recommended by Anderson to ensure the highest numbers of viable seeds. He suggests using tweezers to physically transfer an entire anther of one plant to the stigma of another plant.

According to ANDERSON 1980, Japanese nurserymen are able to get peyote to flowering size in a year to 18 months by grafting young seedlings onto faster growing stock. In FUJITA *et al.* 1972, *Cereus pitajaya* was used for grafting peyote to produce large clusters. We do not know more detail since the article is mostly in Japanese.

This is a very useful technique for propagating large numbers of cactus. It could play an important role in preserving peyote as a sacramentally available material due to being able to rapidly increase the numbers of both plants and seeds..

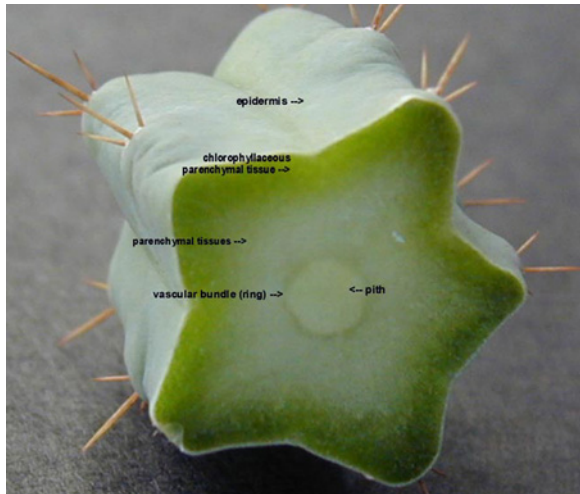
wild plant disfigured by the nibbling of some animal.
Photo courtesy of CACTUS CONSERVATION INSTITUTE



Lophophora grafted onto *Pereskia* (above)



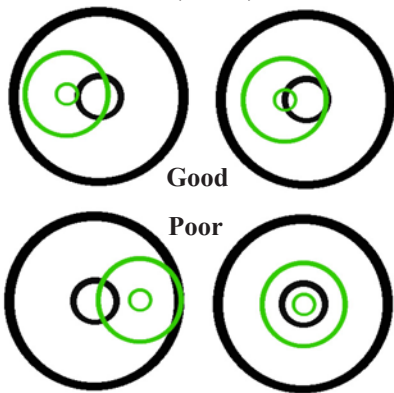
One year later
(above)



Vascular tissues
rising during healing

Cross section
(above)

Mating choices for grafts
(below)



Cut to prepare
for grafting
(below)



Newly healed
graft
(lower right)



Whether grafting has any adverse effects on mescaline content of a large grafted plant or its pups has, to our knowledge, not been specifically studied and reported outside of the work of SINISCALCO [Note 7]. Anecdotal accounts exist of weakness for grafted growth (personal communication with Leo Mercado and with correspondents requesting anonymity) but to my knowledge all of these used young growth (from a few to 18 months old) and did not wait to see how the alkaloids developed over a several year period or more, nor did they evaluate any older grafted plants returned to growing on their own roots and then reintroduced to the soil.



Many grafted globulars, including peyote, have a tendency to bloat and take on abnormal appearances. We have been told of one such peyote that swelled to nearly 6 inches long with a cluster of pups at its base. (We have also seen such abnormal elongation occur, rarely, possibly from stresses like disease and definitely from low-level or point source light in both wild and cultivated plants.)

Another problem with grafted cacti is the tendency of the stock to eventually exhaust itself by supporting its scion. When this happens the scion must be regrafted onto a new stock. Dan Bach notes San Pedro has a longer life than most cacti when used as a grafting stock. [Note 8]

Regardless of grafting's limitations, it certainly is a great way of generating lots of seeds due to causing a hastening of the first flowering and is a good way of increasing numbers of domestic plants, which once returned to growing on their own roots could readily provide many plants for wild crafting or greenhouse propagation. We suspect that grafts may be harvestable and usable as they are. We have neither the experience nor the supportive literature to prove this. It is amazing there is not more published literature on this subject. One anecdotal account indicates that plants obtained via grafting were low alkaloid and low mescaline. The material sampled was approaching a decent size yet resulted from only several months of growth. As with all peyote plants, even grafted plants should be allowed to reach at least two inches in diameter before use and may still require several years at this size to attain a good strength.

The issue of potential mescaline migration was studied by PUMMANGURA *et al.* 1982. (Largely due to concerns that grafting on San Pedro might induce psychoactivity in the graft.)

Mescaline was believed to be locally produced, stored in parenchymal tissues and non-circulating. Cross-migration of alkaloids is believed not to occur. If, for example, a peyote is grafted onto a San Pedro, the peyote will clump in earnest and will grow at San Pedro's far faster rate, but there will be no interchange of mescaline between them.

This was contradicted by the work of SINISCALCO who apparently found mescaline in *Myrtillocactus geometrizans* that had previously been used for grafting peyote. More work is obviously needed to clarify the discrepancies in his account.

When making grafts; cut the stock parallel to the ground about 6 to 8 inches high. (Height is not a critical issue and is more determined by aesthetics than anything.) Obviously it should not be too short as vigorous new growth (transferred into the graft) is desired and very short sections often do not show much vigor.

[Another approach sometimes employed by professional growers is called the 'saddle cut technique'. In this the bottom section has two cuts made so that a ridge is formed while the top part being grafted has a v-shaped wedge cut out of it to mate to the ridge. This is perceived to help prevent movement of the graft during healing and allow greater surface area of contact. If using this technique, positive pressure must be maintained to ensure that air pockets are pressed out from between the mating surfaces or problems will occur.]

Sections of San Pedro with vascular bundles the same size as the grafts are ideal. As is the use of younger San Pedro sections which have not had time to develop a fully woody vascular bundle.



Lophophora jourdaniana
(grown from European seed & grafted)

Short grafts are often used for grafting slow growing commercial plants like crests, when it is desired that the new growth nearly obliterate the view of the stock. These seem to be more common in retail stock and frequently show a short life.

When too tall it will favor formation of offshoots at the apex of the stock that will tend to push off the scion, although many professional growers use a height of 18 to 36 inches for crests and rare cactus they have grafted for their personal collections.

A taller and more robust stock will show a longer life and hence more production of new growth.

Aggressively keep any new growth of spines or offshoots from the stock itself carefully removed.

The vascular bundle must be horizontal, completely flat and visible. All cuts made during grafting must be flat and smooth. Ridges, flaps or waves will defeat the joining.

Chapter 7: Grafting

Trim off the top outermost piece of each rib at an angle so the stock has a beveled edge on the top. This removal of the upper most areoles will prevent these parts of the plant and any spines or new growth they might produce from pushing off the scion and will also better enable healing as the plants fuse and the injury of joining dries and shrinks.

Cut the scion off at the top of the roots making sure that the point of attachment is flat and has a complete and clean exposure, removing any large clusters of spines or downward facing areoles, that might make contact with the top of the stock, (depending on what is present in the species being grafted). If viewed from the side, the bottom will be completely flat and, if viewed from the bottom, the vascular bundle will appear like a ring in the center of the plant.

In *Psychedelic Shamanism*, Jim DeKorne notes that a correspondent recommends that a thin coating of petroleum jelly be applied to the cut surfaces to prevent drying. It did not seem like a good idea to try but wanted to mention it as well as the correspondence with the ENTHEOGEN REVIEW complaining that use of Vaseline for this purpose had killed/disfigured the plants it was applied to. The use of grafting wax is similarly said by REICH 1991 to cause rotting.

When the stock has the scion seated on it, the vascular bundles must match up for the graft to be successful. If they are exactly the same size you can simply center them. If they are of different sizes, the vascular bundles must touch in two points. If they are centered they will not touch and the graft can not take, as there will be no way for the stock to transport water and nutrients to the scion. One point of attachment will work but two are better. When grafting small seedlings they should be placed directly on the vascular bundle of the stock at some point.

(This obviously can work well, as evidenced by the Japanese example above, but I have had relatively little success grafting young seedlings. Use of a *Pereskia* species for the stock, at this stage, is said to be a good approach to dealing with the smaller plant size.)

Speed, while cutting and joining, is a critical point to successful grafting. As is using a very sharp and totally clean knife, large scalpel or razor. Professionals recommend rinsing the blade in a weak bleach solution or alcohol after each graft and then in distilled water before making the next cut. This normally needs to be done only between plants being grafted and not during grafting on a single plant. Any time that injured, brown or rotted material is encountered in making any type of cutting on a cactus, the blade should be cleaned with bleach or alcohol before making another cut. When removing compromised tissue always cut until only sound flesh remains. Working in a clean environment is helpful to success as is being well prepared before beginning. In plants with woody vascular bundles it may be found advantageous to cut the stock well in advance of grafting.

This will prevent the woody fibers from rising and pushing the graft off as it dries and shrinks. Once healed, it is cut again for the grafting operation.

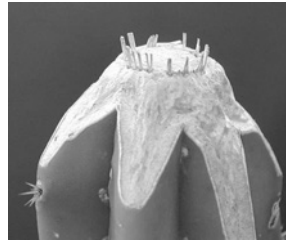
Only healthy plants should be used in grafting.

To minimize the time needed in between the two cuts that necessarily are involved in a graft and hence the potential for drying of cut surfaces, a “*Double-Cut Technique*” was published by Don Bach and is a very useful approach.

The best results will be had when using younger and actively growing stock.

Prepare the stock first, and after making last cut on the stock, cut a thin horizontal slice on the top of the stock, while maintaining the beveled edges of the top. It will resemble a smooth sided pickle slice, and is left in place to prevent drying of the cut.

If necessary use a new blade, as the vascular bundle of a well developed San Pedro can be murdered on knife edges. Immediately prepare the scion by cutting its roots off and place it on the stock just as you remove the small slice. The idea is to minimize the time that cut surfaces are exposed to air.



Prepped & healed



Slice is removed
as scion is placed

A useful modification is to prepare the surface on the tip of the stock for grafting a week or more prior to performing the actual graft. If this is done and allowed to dry and shrink (and partially heal), only a small slice at the tip needs to be removed immediately prior to grafting, minimizing the loss of water during healing. This additionally allows the vascular bundle fibers to rise out of the tip while drying enabling one to cut them off and eliminate any risk of them pushing the graft off as the juncture shrinks and heals. (Tip from YARROW)

Once the scion is in place it must not be moved, repositioned or allowed to shift until the graft takes. Occasionally just the weight of the scion will suffice but it is far better to have a gentle but firm pressure of the scion upon the stock, both to encourage the joining and to eliminate air spaces that will defeat the graft.

Some people use tape (Scotch tape works great! [but see Note 9]) or string with small weights or stakes on each end to hold it down. The Lamb's Exotic Collection in England, uses wire hoops which are placed over the cactus, holding the scion down by pressing the ends into the soil. Other professional growers use a special metal stake, with a short flat bar attached to one end like an upside down letter “L”, to apply pressure on the graft.

Don Bach successfully makes grafts onto short, cut sections of San Pedro, using two rubber bands at 90° from each other to secure the scion and roots the grafted stocks after they have healed. This is the same strategy used by commercial Japanese grafters.

When taking this approach, the Pedros should be cut into sections a week or two before grafting so the bottom end has a chance to callus and resist damage from the rubber bands. (If small, the rubber bands can be stretched around the pot itself.) Mr. Bach and Japanese grafters use rubber bands with great success but I have not shared their results. The yellow plastic bands on dust masks (tied together) work well and do not crush the plant. Similarly, strips cut from women's nylons and snagged on the spines of the stock work quite well for securing scions.

REICH 1991 recommends that a cotton ball be placed on the very top of the plant to relieve pressure from the rubber bands. This is a very nice illustrated article on use of the saddle cut technique. The only criticism is about their suggestion that one can alternately pin the scion onto the stock by running a toothpick straight down through both plants. Such an invasive injury substantially increases risk of both disease and insect invasion.

A useful trick employed with great success when grafting columnar cacti onto other columnar cacti is to make the graft as normal and apply a thin ring of Super-glue or similar cyanoacrylate adhesive around the periphery of the graft, while maintaining constant pressure to ensure that none can get between scion and stock. Maintain constant pressure until the glue has gone white and is no longer liquid. If it can get between the plant surfaces, the graft may be defeated.

So far the success rate when using this for grafting columnar species has been 100%. Attempts to use super glue for grafting seedlings, tubercles or wedge grafts have largely been failures.

Work on this subject is still in its preliminary stages but experimentation with its use for normal grafts is indicated and highly recommended.

During the healing period the newly grafted plant needs bright light and must not be exposed to any temperature below 70°F. It should also be protected from ANY full sun and contact with rain or any other moisture. The Lambs, propagating in greenhouses, cover their newly grafted plants with paper to protect them from the sun [Note 10].

Time for the graft to cure will vary. It should take less than a couple weeks (7-10 days is normal) but it may take up to several months before vigor returns.

During this time watering of the stock itself can proceed as usual. (REICH suggest that watering normally not be resumed until new growth is noticed)

If the stock and scion were accustomed to full sun prior to the grafting operation, there should be no problem with putting them back into full sun within a week after the graft is performed.

No matter how old, grafts can always be rather easily knocked off if struck, especially if chilled.

It is my opinion that grafted plants should be protected from any temperature below 60°F for **at least** several months after grafting.

Practice grafting on common cacti before attempting to graft a rare one. It takes a little practice but is well within most people's ability and is a valuable and rewarding technique to master.

Whether people are amateurs or professionals, I would strongly suggest obtaining the grafting guide written & published by SACRED SUCCULENTS. Their address can be found listed in our reference section.



***Trichocereus* cv. *Juul's Giant* healed and growing after grafting onto *T. pachanoi* with superglue**

Cultivation of San Pedro

The notes below were written specifically with Pedros in mind. Most of the observations are applicable to other cactus. The main exceptions are frequency of watering and feeding. Many cactus including other *Trichocerei* are very rot prone if overwatered. Pedros are as well if wet during cold weather. However, Pedros thrive on heavy watering when hot. They are very appreciative of thorough daily watering during the summer. Too frequent of fertilization in any plants including San Pedro (*T. pachanoi*) will result in weak disease-prone growth and, especially in globular cactus, often a bloated appearance. They will generally be rot, pest and disease prone.

If a person uses a low concentration of soluble fertilizer as the only water that is given to seedlings the growth rate is amazing. This too causes bloating in some species.

It also favors rotting in many species. Commercial growers overcome this by adding Benomyl™, a non-food-safe toxic systemic fungicide to their watering solution every time they water. If growing food or sacramental plants this is not an acceptable approach.

I have been told that *T. peruvianus* will also handle heavy watering but mine seem to tend towards black rotted spots unless watering is moderate and only in hot weather. *T. bridgesii* seems to prefer much drier conditions, as does *T. macrogonus*, *T. taquimbalsensis* and *T. validus*.

I have seen San Pedro (dry) handle 6° F during a week-long cold spell that never saw the temperature rise above 15°. I have also seen them turn to bags of slush at 28°. Normally they do not have a problem with light freezes especially if they are in the ground. If temperatures in the low 20's are expected, protect or uproot and bring indoors. I have successfully overwintered bare root plants, standing upright, closely packed in crates, in a bright spot with only indirect light (indoors) with very little loss (less than one percent).

ANDERSON 1998 notes that *T. peruvianus* can tolerate brief periods down to 25°F.

High altitude collections of San Pedro are in cultivation. These, *T. bridgesii*, *T. macrogonus* and *T. peruvianus* are said to be fairly freeze hardy; if totally dry. *T. terscheckii* appears to be hardy even if wet.

Perhaps due to the often high winter humidity, in Central Texas, *T. bridgesii* & *T. macrogonus* have proven hardy only to around 28-29°F whereas in the wild much colder temperatures are to be expected. In northern California, both species have thrived down to 20° F with little loss although some forms of *T. bridgesii* do not look happy during winter rains. Interestingly the intermediate forms of *pachanoi-peruvianus* have thusfar shown the most problems with cold and wet (at least for me)

Trichocereus species always perform best if given free root run. This is also the situation where most people are likely to see their *Trichocerei* flower. However, many reports of larger potted plants flowering also exist but it is claimed that they must be extremely root bound for this to occur.

They also seem to like limestone and volcanic rocks to be present in the soil. With the exception of those species that naturally grow under trees or amidst shrubs, our best plants are those grown in full sun and watered heavily during hot weather.

It might seem counterintuitive but the fat pachanoids that naturally occur under heavy tree cover will get their best girth if they receive only partial sun with dappled light the rest of the day.

Trichocereus pachanoi
cv. Super Pedro



Growing in full sun, using 5 gallon or larger pots, one plant per pot, and 2 inches of limestone rock on the bottom as a layer, with crushed lava rock or pumice mixed with the soil has given my best container grown results. They seem to do better with a bulb pot, an *Azalea* pot or other wide pots than with a standard pot. Be certain that all pots have drain holes in the bottom. A convex side up small piece of broken clay pot is ideal for covering the hole and retaining dirt while maintaining drainage. This is an old nurseryman's trick which will not clog up with time like a rock or Styrofoam peanuts will. (Taught to me by an old nurseryman)

Many people swear by clay over plastic pots but I have found little difference except for retarded growth rates due to excessive accumulation of heat when 1 gallon black plastic pots are used in mass plantings. The plants seem to struggle with being literally baked by the black pots absorbing the summer's sun and sometimes two waterings a day in Texas are necessary just to keep temperatures down until placed in a larger pot. One gallon green or grey plastic or other sizes of black plastic pots do not seem as much of a problem. If using plastic pots it is crucial that a bottom layer of rock or inert material is used, both to ensure good drainage and to prevent the cactus from getting 'wet feet', a rot promoting problem due to moisture accumulation where the bottom layer of soil (and roots) contacts the plastic. Increasing pot sizes gradually, as they become rootbound, rather than jumping to a large pot, will also help maintain root health. If grown in the ground, plants will often appear to do nothing after being planted. This is deceptive as they are spending their energy developing good root systems; once the roots are well placed, growth should be rapid.

ANDERSON 1998 comments that *T. peruvianus* is tolerant of bright light but that hot full sun will cause it to suffer. This is true of many *Trichocereus* species including San Pedro. While the best and most robust growth will in fact occur in full sun, high heat during summer severely stresses the plants. Shade cloth is a common and simple solution.

The plants will sunburn easily if introduced to more sun that they are used to. This initially appears as bronze or yellowish areas and leaves permanent scarring that looks like tan patches where the sun was strongest. Sometimes it is slightly raised and bumpy. Larger flat areas go grey with age. If damage occurs to the apical meristem itself, new growth will stop until a new shoot can form near the injury.

This is easily avoided by introducing the plants to greater light levels gradually. Once they are accustomed to it, they love full sun and will not burn. Young shoots that start off life in full sun are always the most robust specimens and 3 feet of growth per stem per year is normal if they are happy. I have seen even more than this in well fed and watered plants. If every plant does not show at least 6 inches of growth per year, on every stem, even if unfertilized, the plants are not happy.

(One friend took a two foot tall plant, given to them for a wedding present and gave it regular feeding with Miracle Grow and heavy watering (daily during hot weather). In 7 years, it produced a total of over 35 feet of 3 to 4 inch in diameter stems that would break in half when they got to around 8 feet tall and exposed to heavy wind. It additionally produced a good number of cuttings that were rooted and given away.)

Full sun is crucial for maximum growth and girth but a delicate balance may have to be found when introducing plants to higher light levels than they are accustomed to. Some will respond and grow best if they have very bright light but not full sun when temperatures are high.

A trick used by many professional growers is to add soluble fertilizer at 1/10 the recommended concentration every time they are watered.

Alternately a low strength broad spectrum food and trace mineral source like fish emulsion and liquid seaweed can be used (Follow the recommended feeding schedule but mix at 1/5 concentration or less). I prefer to feed lightly every 2 to 4 weeks from spring through summer. These plants are different from other cacti in that they can take, and enjoy, being watered every day if the weather is hot and sunny. They should not be watered during cool or cold weather.



scarring from a sun burn

Normally watering is discontinued in fall and the soil is allowed to go through winter quite dry. If a plant seems stressed for moisture during winter I will give it only tablespoons until healthy. [A plant has more likelihood of surviving the winter when shriveled for a month or two than being wet and chilled.]

The soil should be well draining and rich. It should drain rapidly and thoroughly and not retain moisture. Peat should be avoided for all cactus soils if possible. (Some growers seem to have no problems with it.) Bark and sawdust and other forest products sometimes cause similar problems in some species due to presence of decomposition organisms that can eat the cactus roots. Bark frequently supports fungal growth unless thoroughly composted. If using bark mulch, all chunks should be removed by screening. (Some growers apparently have no problems with it also.)

Besides harboring bacteria, fungi and viruses that are not conducive to good cactus health, once peat dries completely it makes making future acceptance of water difficult. Water then runs over and around it, never reaching most of the roots or wetting much of the soil. This is an underappreciated source of cultivated plant death in those species that require drying of the soil.

The ideal component is thoroughly composted oak leaf mulch. This is often difficult to obtain in quantity unless done yourself. Sedge peat (neutral peat), the thoroughly composted layer below peat moss, is also an acceptable choice.

Incorporation of a surfactant (like a mild dishwashing liquid at around a teaspoon per gallon) to water or the fertilizer mix will enable better wetting action. It will not hurt the plants.

Coir, (ground coconut hulls) is becoming increasingly popular with cactus growers as a superior substitute for peat. It appears to suppress fungal growth and holds up longer than peat. Once it is dry, it accepts water only a bit better than peat so should never form over 15% of the total mix..

Chapter 7: Cultivation of San Pedro

If you are mixing your own soil and are adding sand; use only washed coarse sand (river, builders, coarse mason's or granite) or else take your sand and wash it through a window screen (or finer mesh) with running water using only what doesn't pass through. If this is not done, the fine particulates (clays) can eventually cause the soil in the pot to set like a rock, killing all but the largest and most peripheral roots. Let the washed sand dry out before mixing the soil.

Perlite, pumice and crushed lava rock are also good additives.

The best blends will be at least 60% inert drainage promoting ingredients and the rest rich food such as oak-humus, compost and well aged manure. Screen all organic material (use what does go through 1/8th inch or larger mesh) and remove any long pieces that go through. **Be certain that all material is completely composted.** Vermiculite is useful only in seed starting mixes when moisture retention is desirable and has bad packing tendencies with age.

Several examples of published soil mixes used by successful commercial and professional cactus cultivators:

A. A half ton, each, of pumice, humus and sand mixed with 10 to 15 pounds of gypsum.

B. 2 parts local soil (SW desert), 2 parts vermiculite and 1 part Perlite. They feed their plants and regularly replace the vermiculite to compensate for packing.

C. 2 parts decomposed granite, 1 part compost, 1 part pumice, and 2 parts sand.

D. 50% coarse sand, 30% sandy loam (well screened) and 20% gritty material such as pumice and perlite. They use this mix for North American cacti, *Mesembryanthemums* and Chilean cacti. They replace the loam with peat for other South American cacti.

Use an appropriate dustmask (P100 or N99 NOT N95) when mixing soils or when working with perlite or pumice.

Adding blood meal is an easy way of providing a slow release nitrogen source for enhanced alkaloid levels.

JACOBSEN 1960 insists that "well weathered loam" is essential for *Mesembryanthemums*. Much of what is sold in this country as 'loam' is not loam suitable for agricultural use. Only sandy loam should be used and must contain at least 50% sand with a minimum fine sand content. Clayey loam and silty loam are also frequently sold but are not acceptable soil additives.

The BEST soil mix will be what can be created using your locally available raw materials.

A healthy plant is solid and firm to the touch. If the plants seem soft they may be in need of water. If a single watering does not make them hard, **discontinue** all watering until they recover. If they continue to get worse; uproot them and check for bad roots or soil pests. Cut out any rotted or compromised material encountered. [See elsewhere here for dealing with pests.] Sometimes moving into the sun a little more will solve the problem. If a plant is soft to the touch keep a sharp eye out for rot. Always separate sick plants from the healthy ones. If rotting occurs at the base, cut the plant off until only healthy tissue remains. [Do not make another cut until the knife is sterilized or cleaned well.] Then callus & reroot.

A useful trick for stimulating formation of basal pups as a source of cuttings is feeding with Miracle Grow™ once a month during spring and summer. Miracle Grow™ stimulates offshoots substantially. We have tested this, under controlled circumstances and also in comparison to a wide variety of other food sources, many times over the years and nothing compares to it for inducing rapid, often **multiple**, pupping. When grown in full sun, pups induced in this way are always the largest, fattest and fastest growing of any of the San Pedros produced over the several decades during which I have been seriously growing them.

I normally feed lightly with fish emulsion and liquid seaweed several times throughout the growing season and think it maintains the health of the plants very well. When used by itself, the combination of fish and seaweed does nothing as dramatic as Miracle Grow™.

Some people dismiss Miracle Grow simply for being a 'chemical'. All fertilizers are chemicals; for that matter, so are the plants and so are we.

Soluble fertilizers do have the disadvantage of providing nutrients only when applied.

For cactus this may be advantageous. For example; some extremely rot prone cacti can be grown in pure sand or grit and provided all nutrients via regular light feedings. Use of a soluble fertilizer ensures that very little organics remain in the 'soil'.

Soluble fertilizers are also said to kill soil bacteria but we have not found any actual published documentation of this.

They are also said to add mineral salts that can leach to the top and form a crust that is capable of killing sensitive seedlings [Note 11].

We feel their advantages outweigh potential problems especially if they are used only for pup stimulation or maintaining rot prone cactus in a nutrient-less medium. Following their use, we typically flush the soil to get rid of any excess salts.

Alkaloid levels certainly do not seem to suffer from the enhanced rate of growth. (Based on subjective evaluations involving bioassays of known amounts of cactus.)

If anything, they always have seemed to be the strongest and the best for sacramental use; especially if they are older plants that were fed with Miracle Grow™ regularly over the course of a few years. Again, this is based purely on subjective evaluations. We are not in a position to do rigorous quantitative analysis of the cacti we propagate.

In other plants, ammonium as the source of nitrogen generally favors alkaloid production, while nitrates tend to favor vegetative growth. Both will increase alkaloid levels above baseline. While in depth scientific studies have not been published on San Pedro, we would recommend using ammonium as a nitrogen source in preference to nitrate. Slow release nitrogen sources, such as blood meal, have been demonstrated, in a Czechoslovakian study using greenhouse grown plants, to increase alkaloid levels in Peyote by nearly 60%.

The most successful grower we know uses **EM-1** (microbes) to inoculate their soil. This works fantastic enabling fat columnar *Trichocereus* to be grown to flowering size in 5-gallon containers. It decomposes everything possible in the soil mix, even coir, so it is necessary to replenish the soil as the level in the pot drops.



Unlabeled plant (Knize) that sat in storage for too long of a period before being delivered

Physically handling cacti

Many cactus people use neither tongs nor gloves in handling their plants. Most of us still have spines tips in our fingers. I suggest the use of tongs for handling them.

Tongs work well for small plants but can crush or damage larger ones. Cushioning can be added to the tongs if well secured. Layering cloth around the tips can help protect harming spination or crushing flesh but several different sizes and configurations of tongs or even chopsticks might be found helpful for handling differently sized and shaped plants. Barbecue tongs and ice tongs both can be quite handy but wooden ones can cause less harm to the plant.

Gloves can be of help but will need to be discarded regularly as the broken spine tips left in their fabric will work their way through to the inside over time.

An easy and potentially painless approach when making cuttings or handling plants is to wrap several layers of cloth around the section to cushion the holding spot and to protect the spines. Place a layer of corrugated cardboard over this to use as a protected handhold.

If moving or manipulating long sections, take narrow lengths of corrugated cardboard; long enough to go around the plant and still leave 4-6 inches of extra at each end. (cushioning can be used as mentioned above) Now line up the two ends with each other so they form a single tablike projection. This can be used to hold the plant as is or you can give the ends a single twist to give a safe and secure handhold. A fat rubber band or duct tape can secure the cardboard to itself if needed.

For moving or handling long sections, space these disposable "handles" every couple of feet along the length of the cactus to allow it to be manipulated without breaking.

This will require a second person if the plant is 3-4 feet or taller in height.

Fragile spines can be well protected by carefully packing with cotton although it should be understood that the cotton's subsequent removal may be time consuming.

If handling or moving a large and heavy (and heavily spined) cactus such as *terscheckii*, cut a strip of old carpet long enough to wrap around the plant two or more times. The plant can be rolled up in the carpet and the carpeting secured with rope or nylon strapping that can be used as handles. Great care must still be taken as *terscheckii* spines can readily cause deep puncture wounds.



This can also be used to permit easier handling during planting. If the carpet is longer than the cactus is tall the secured roll of carpet can also be a handy way of transporting them.

Shipping & receiving a cactus

Being able to successfully ship and receive cactus is an important part of modern cactus collecting.

It is easy if always permitting cactus cuttings adequate time to heal before packing. Failure to do this will often result in rotting during shipment or the formation of mildew or other problem organisms on the cut surfaces (which often leads to rotting once planted) Mildewed, dark, olive or reddish surfaces on cuttings indicate a plant that should be closely watched for rot development once its planted. Most times a plant can outgrow this just fine but I would suggest that they might be best recut and healed if either anything colored or mildew occurs on a *Trichocereus* cutting.

If mildew is recurrent, scrub the mildewed surface with a toothbrush and a strong bleach solution. Wash it clean, recut the end and permit it to heal. Or allow the entire cutting to soak in a solution of ConSan-20 or PhySan-20 for 15 minutes and permit it to dry and heal before replanting them

If in doubt; wait. A cutting can survive even a few weeks of excessive drying time better than a few days too little.

Once plants are received they should be immediately unpacked for inspection and be permitted to breathe even if planting is not possible. Both the box should be opened and the inner packaging unwrapped to expose the plants to light and air circulation. While exposure to direct sun must be avoided, it is important to introduce the new arrivals to as much bright light as possible as soon as possible. Once planted they should be gradually worked into their preferred level of sun in order to prevent burning. This should proceed as rapidly as the plant will tolerate however in order to prevent etiolation. (Etiolation, the abnormal skinny growth produced by inadequate light levels.

It is usually harmless beyond introducing what often becomes a weak spot when provided with adequate light later but does form, sometimes unsightly, permanent constrictions.

If roots are present any dried portions should be cut away to prevent their rotting when planted. If the moist inner flesh of any roots is exposed during this process permit the injury to heal and dry before planting.

We would suggest planting, watering to set the plant and then withholding water until new growth is noticed.

Packing cacti is also simple.

Labeling the cacti so that their labels remain with them during unpacking is quite important.

Labels can be rubber banded to the plants, wrapped within their paper wrapping or written directly on the cutting using a fine tip Sharpie or a soft wax pencil.

As an act of kindness, a cautionary sign should be placed as the very top layer if any long spined cacti are present.

The first step is wrapping a layer or layers of newspaper or similar around the plant. If it has fragile spines these can be protected by use of cotton balls (a pain to clean but very functional) or foam packing peanuts carefully positioned and held in place by the newspaper wrapping.

In extreme cases of long spines a trough can be made from newspaper (add a cardboard layer if it is heavy) then partially filled with packing peanuts. The cutting is laid on this and as the trough is gathered into a tube around the cutting, it is filled the rest of the way with more packing peanuts. The entire lot is then secured with tape to retain the peanuts and prevent the cutting from shifting.

Wads of paper can provide a first layer in the box as can bubble wrap and foam peanuts. Bubble wrap and spines are not friends.

Gently lay your wrapped cuttings onto this layer and arrange them as tightly together as possible to prevent their ability to shift in transit. Short rolls of thin cardboard can be made to fill spaces.

Care should be taken to pack wads of paper or bubble wrap or other packing materials between any that might puncture each other. Wads of packing material can then be used to fill the remaining space in the box. They should never be wrapped or sealed in plastic.

An inch or two minimum should be left on all sides of the cactus in the box which is then securely closed.

Cactus can easily survive more than a week or more packed like this so long as they are not exposed to temperature extremes. I've seen international shipments recover after spending months in the mail system. Regardless, packaged cactus should be shipped and unpacked as soon as possible.

Cuttings need to be completely healed prior to packing for shipping or they may have mildew or other problem organisms growing on their cut surface by the time they are opened.



In the event anyone wonders what can happen, the cacti shown in the photograph above arrived from a Canadian vendor who said they had never heard of it being necessary to permit cacti to heal before packing them in a box and shipping them from the Dominican Republic to the USA..

Seedlings and small plants can be treated the same way except that they should have all soil gently knocked free from their roots and should never be shipped with soil.

Usually a soft brush can aid in its removal as most of the soil should fall off readily.

In the case of fine feathery spined or hairy species, presence of any soil during shipping can result in permanent soiling and discoloration.

To ship between countries soil-free bare-root conditions are required. (Permitting is also required in most countries)

To prepare a plant for soil-less bare-root shipping, first wash the roots free from soil under running water; using a soft toothbrush to remove and visible soil. There must be no pests present, such as scale, nor can there be any visible rot or decay.

Place in a bright, warm and dry place (ideally on a screen) to permit rapid drying and then pack as described above for cuttings.

Turbincarpus jauernigii
Received in mail with bare roots (these came from a domestic source so were not washed).

Propagation of San Pedro by cuttings

A good procedure for increasing specimen numbers and also generating plant material for sacramental use is by making cuttings:

It is essential that a sharp and clean knife be used. Cuts should be made straight through. A sawing action with a knife, especially if not sharp, causes crushing of tissue and increases possible problems when rooting. For older large cactus it should have a long sturdy blade. A butcher's knife works very well. For older plants or those with a woody core a Japanese-style pruning saw works great.

In the published literature it is said that an electric carving knife works well for "making the large numbers of cuttings needed in commercial operations". I have not tried it but thought it was worthy of mentioning.

The plants are first allowed to grow to between 4 and 6 feet tall. Then the tops are cut off as 1/4 to 1/3 of the plant. If the section is long enough, the last 8 inches to a foot including the apical meristem is also cut and calloused as a new cutting, i.e. the cut section is divided into two cuttings, one being the tip of the original plant and the other the section below it. Very small sections of cactus will root and form new plants but cuttings of less than 6 inches commonly produce weak plants that require several years for regaining vigor and good establishment.

Cuts are made at a slight angle so that there will be no flat tops to catch water during rains. The flat ended section left from dividing the original cutting in two can be calloused for planting or it can be kept frozen until needed for use.

It may be found convenient to clean, slice and portion (weigh) cactus before freezing as it makes them easier to handle later.

San Pedros normally branch from the base. If injured by being cut or having the tip damaged by sun burn, fungus, insects, birds etc... they will form branches out of the healthy areoles adjacent to the injury. Plants will sometimes send off several new shoots.

These are allowed to grow until they are a foot or more long and then cut off at their point of attachment to re-root as new plants. The plants will respond by sending off new shoots. The same is done with the new offshoots.

Basal shoots are treated like the parent stock. They are allowed to reach at least 4 feet before cutting off the quartermost tip for rooting as another plant.

After 5 to 7 years of this, each mother plant will generate many plants. The new plants that are generated are treated the same way.

Once they are 5 to 7 years old or more, after again removing the offshoots from the top to be rooted, the original trunk is cut off at about 8 inches to a foot from the ground.



The bottom portion will never be cut again and is allowed to become either a mother plant for new shoots, which can then be cut and rooted, or simply allowed to grow as a nice clumping specimen.

The older section that was removed can also be cut into 8 to 12 inch sections and each rerooted for sources of new offshoots.

However, these can be very potent and it is these older sections that are preferred for consumption. If a person does this every year, not only will they generate a lot of plants but they will have a steady supply of old and very potent stock every year after the first five.

Plants which have been taken as cuttings should be kept in a warm, dry, brightly lit place out of direct sun. If they are kept on their side, the tips of cuttings from the end of branches will tend to grow upward making a bend in the cactus once it is again rooted. This can be avoided by drying the plants while standing them on end (first allow 1-2 days on their side), supporting them in totally dry sand (frequently check for signs of decay), or propping them up until healed.

While new cuttings should be kept out of sun, there was also good success, when making cuttings on plants which were accustomed to heavy sun exposure, by taking the cuttings and propping them up inside the edge of larger pots of plants so that they received enough sun to prevent bent growth. This is guaranteed death for cuttings not used to a lot of sun. Normally when doing this the cut end of the section is exposed to direct sun for one day. Once again, this is guaranteed death for cuttings not already used to a lot of sun.

When removing shoots its best to cut at their base. If you cut higher up, the next set of shoots will be from the top section of the old shoot and will be weak if exposed to wind. If new shoots are sprouting from the main trunk, they can tie directly into the woody vascular bundle and will both be mechanically stronger and grow faster and fuller.

If a thick older section is being cut, it will have a woody fibrous cylindrical core. Rather than attempt to cut straight through; push the tip of the knife, point first, into the center of the stem until you feel it crunch through the layers of fiber, push it gently through the core in one direction (careful wiggling or rocking of the knife may be helpful), remove it and repeat the other way into the same incision. When this is done, cut the cactus the rest of the way through.

[A good pruning saw will also work quite well for this.]

Trim any loose flaps this operation may cause to prevent potential rotting problems when callusing or rooting. Save and dry all scraps as they can really add up over time.

Many people dip the cut surface of cactus cuttings in powdered sulfur, charcoal, ashes, fine sand, dry dirt or a rooting hormone [Note 12] to prevent rotting and stimulate rooting. I have used almost all of the above and find that just allowing them to callus adequately is sufficient.

Normally 5 days in a dry place is sufficient. It will vary somewhat from plant to plant and high humidity may require much longer periods. Look for the vascular bundle to pull up from the surface of the cut and a visible drying to occur. If in doubt, wait a few more days. Cuttings can more readily survive too long of a healing time than too little. Some people even prefer to wait until new root buds appear at the base of the cuttings before they replant them.

Plant several inches deep and water sparingly and infrequently until you see noticeable growth on the cactus. Lack of water and receiving small infrequent waterings will stimulate root formation faster than the presence of water. They form roots to find and recover water, not in response to an abundance of water. If you withhold water for around a week, fresh cuttings can be planted immediately but I consider it to be risky due to potential rotting problems.

There are growers who just cut off the tops of their plants and plant them immediately with no problems (and also those who do not care which end is up or down and have no problems.) Their thumbs must be greener than mine because I have not shared their success. Adequate callusing is strongly recommended prior to planting.

A handy trick is to plant the healed cuttings in pure dry sand and repot them in soil only once nice roots are actively forming. This is useful for rot prone plants but works great for other cacti as well.

Laying long cuttings on their side on sloping soil or a berm to create mother plants is a great production method in a mild climate.

Some people plant their cactus cuttings deep. Unless it is a large specimen that needs the support, this can encourage rotting. I prefer to prop up those plants which won't stand up, with the 2-3 inches deep they are planted (much less with small plants or cuttings), using one or more rocks, a layer of crushed lava or stakes which are removed as soon as they are anchored by roots. Usually a few weeks is enough.

People also recommend planting plants deeper every time they are replanted. For some plants, especially tropicals that readily root along the stem, this is a good procedure but with cactus the soil level should be kept the same. Deeper will encourage softening and moisture problems (potential rot) of the stem and not as deep leaves the now nonchlorophyll containing outer layer exposed to weather, sun and pill bug damage etc.

In a large scale rooting operations, for experiment's sake, rooting hormone was used on half our cuttings and nothing on the other half. I was unable to tell ANY difference either in speed of root establishment or in root growth vigor and subsequent plant growth.

I do use sulfur but only if a specimen has recurrent problem with rotting or when rot is a potential problem. For example, if you are harvesting plants and feel that rain or moist conditions may soon occur, it is a good idea to dust the top cut surface with sulfur. A hand-engraver's 'pounce bag' using sulfur, rather than French chalk, is very useful for this.

To make one, take a piece of thin and not finely woven cloth, such as a bedsheet or summer shirt of dishtowel, cut a square about 6 inches on a side, and place a heaping tablespoon of powdered sulfur ("Wettable Dusting Sulfur" from your local garden supply store) in the center. Gather up the corners and edges, then wrap a rubber band around it forming the sulfur into a loose ball.

A gentle tapping of the top of a cactus with the ball will allow the fine dust of the sulfur to come through the fabric and evenly coat the injury. Do this until they are no longer wet where cut. Replace the sulfur as it becomes depleted. If the weather is sunny and dry, this is not necessary.

Many growers swear by powdered charcoal or even ashes rather than sulfur. (Make it yourself by burying burning wood and powdering the resulting charcoal. Do not use charcoal briquettes)

According to some people, even numbered ribbed plants are said to be somehow "evil" and only odd numbered plants are considered proper to ingest [Note 13]. We have not found any noticeable difference. We specifically select for 5 ribbed clones but a 5 ribbed plant may send off shoots that have 6 or 7 ribs. And vice versa. About 60% of the time when a plant is cut the new growth will have one less rib than the main plant (unless the parent had 5 in which case it will produce shoots with 5 or more ribs.). The remaining 40% there is no apparent pattern to the numbers of ribs on new growth. I have some plants showing 5, 6 and 7 ribbed branches all on the same plant. I also have some where all branches have 5 ribs but only occasionally encounter 8 or 9 ribbed plants.

Trichocereus pachanoi



Manuel Torres commented to me that the primary reason some Peruvian plant sellers collect plants with specific rib numbers is to indicate that the collection originated from within their family.

Thin ribbed plants are stronger than fat ribbed succulent plants. Older thin ribbed plants are amazing. This is due to the fact that thin ribbed plants have a greater proportional surface area (weight for weight) than similarly sized fat ribbed plants.

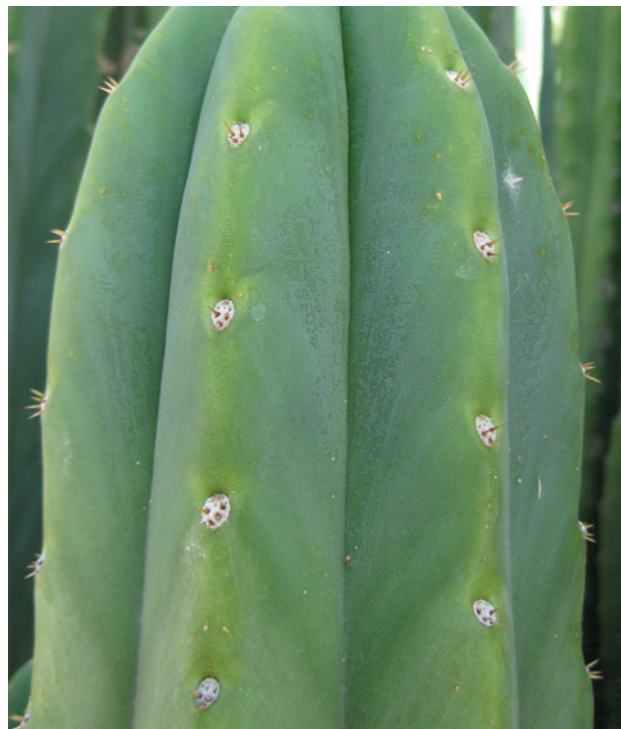
Alkaloid content is highest in the parenchymal tissues. This includes both the thin green chlorophyll containing layer and the far thicker layer of storage cells beneath it. This does not mean alkaloids are absent from the central tissues. The concentration is just lower in the core.

In Peyote, it is generally the case that only traces of mescaline are present in the roots. For most populations (such as Texas peyote) this is true. However, TODD 1969 found Coahuilan plants that contained as high a concentration of mescaline in their roots as plants from San Luis Potosí had in their tops. The latter plants showed only minor amounts in their roots (The normal Texas peyote plants are similar to the San Luis Potosí population). [See the *Lophophora williamsii* entry for more info.] This needs more study.

The Coahuilan plants were significantly higher in the mescaline content of the tops.

Harvest of the roots means less peyote in the world. Use of root tea by people who do not plant peyote or return seeds to the wild pays lip service only to the claim of having some level of respect for the peyote. The current philosophy of immaculate germination, as practiced by those duly-licensed peyoteros who harvest prior to flowering age, is another concept in need of extermination.

Well fed or older plants have always been the strongest for consumption (if all other factors are equal). Old woody sections are often weak. While all evidence strongly suggests that much of the material traditionally used in South America is far stronger than much of what is cultivated for horticulture, younger branches can be consumed and are sometimes preferred in South America for healing purposes. Their purposes are not always totally synonymous with our own. In traditional healing practices small doses are often preferred, especially for 'the patient', and strong hallucinations are considered undesirable.



Healers tend to use larger doses than those they treat. Such healers also routinely use far larger dosages to directly learn from the plants than they do in their healing ceremonies. In our practices these higher levels of experience are what is often being sought. My focus is spiritual work and study, not the healing of others. (I do not consider myself qualified to treat others medically.) Maximizing the mescaline content and dosage will make this more readily achievable.

Age and history of nitrogen incorporation appear to be the two next most important variables; after strain or clone line. If possible, proven clone lines should be selected when propagating for sacramental stock.

There is however one additional factor that may be important (my personal belief is that it is one of the top four factors), that being watering history prior to harvesting. Some growers prefer to withhold water for a period of time (several months) prior to harvest believing that this will increase their alkaloid levels. Whether this is actually a function of water deprivation or simply dehydration stress remains to be rigorously studied in *Trichocereus* but SINISCALCO reported an alkaloid content, in peyote he had starved for water for six months, that was 27.4 times higher than plants heavily watered up to harvest (0.1% vs. 2.74%). (More comments within note 7.)

Friends who use only dried *Trichocereus* plant material report that this is not their experience and they have observed no correlation between alkaloid levels and watering. They have commented that material propagated in a greenhouse is far weaker than the same material when grown outdoors.



A backyard *pachanot* propagator in Texas.

I presently suspect our difference is due to their reliance on thoroughly dried powdered material instead of fresh plants.

More work is needed to establish the actual relationship between alkaloid production and water or nutrient availability and also potential seasonal or other alkaloid fluctuations.

Another useful technique for mass producing biomass or stock for commercial production is to root the San Pedro by lying the plants or long sections of plants on their side, prostrate, flat with the ground or nearly so on a slight slope or berm. The latter is better if they are exposed to rain.

If they touch soil along their length they will root at multiple points and start sending up offshoots; often from both ends and more rarely from the center. These can all be cut and rerooted. If subjected to repeated mass harvests, after a few years the mother plants this way can become exhausted and rot prone.

The predominate San Pedro in the USA;

<http://www.largelyaccurateinformationmedia.com/LAIM/pedro/pedro.html>

Chapter 7: San Pedro propagation

Sometimes, Pedro will have a tendency to fall over and, if elevated, grow downward and then horizontally, with the tip growing like a snake poking its head up. If allowed to do so they often will send up pups not only from their base but along their length at multiple points (especially at points of mechanical stress).

The parent stock will become woody but weak and it may need some support to keep from snapping once the pups start growing. It is better to remove them and root them on their own. (The snakelike sections can be quite potent.)

Trichocereus peruvianus will usually show a far greater tendency to grow arching or even prostrate with age. This is its natural and normal growth habit. Shelves on rocky Peruvian cliffs can be found that are literally lined with this species growing downward and outwards; resembling an explosion of snakes.

As plants grow, they will lean towards the sun. This is because the natural tendency of plants is to grow on the side away from the light thereby pushing the plant more into the light. Plants in containers can develop a lopsided appearance unless rotated to allow more even growth. Any that are noticed to be growing unevenly are rotated 180° from where they were and I also try to rotate container grown plants 90° every month or so.

Established plants which are growing in a bed or outdoor garden and needing to be transferred to containers or a different garden bed should have a chalk mark gently made near the base on the side facing south so that once potted it can be kept oriented the same way. Failure to do so can result in serious sunburn injury to the parts of the epidermis which had never previously seen full sun.

If the soil level drops, over time or with watering, it is a good idea to back fill with fresh soil or gravel bringing the level back to where it was. [For young seedlings; use a very fine and screened material or small coarse sand. Backfilling will help protect young roots.]

Another practice that is regularly employed is to use a one or two inch deep layer of rock, lava rock or limestone gravel, on top of the soil in potted cactus. I will most often fill pots right up to the top with smallish, coarse rock.

This helps anchors the plants while minimizing the actual soil that makes contact with the skin above the base. This is very useful to apply to rot prone cactus that do not tolerate moist soil contact well. In this latter case the plant is planted so that only the roots actually touch the soil and the base of the cactus and its larger roots are totally surrounded by rocks, gravel or washed granite sand (with fine particulates screened out). Basal shoots, such as are seen on San Pedro will usually just push what rock they need to out of their way. Occasionally they will need assistance.

It serves another purpose by giving a surface which can be watered without splashing dirt or soil onto the lower section of the plant. Aesthetically it not only looks attractive but keeps the plants clean. This is very helpful, especially if the species is hairy or densely spined and catches and retains dirt as a result.

This can also be done in an open rock garden to keep the plants clean. It makes a very attractive display and rock colors can be chosen to accentuate the body colors of the individuals or even to mimic the natural habitat of a cactus species. Limestone complements peyote very well.

Melocactus acispinosus





Problems & pests

Pedros aren't bothered by many pests.

Occasionally they are attacked by minor fungus diseases that look like small blisters, or raised brownish or black patches. These generally dry up and present no problems if watering is cut back and the plants allowed to dry out completely or if it is moved to an area of less humidity and greater light. [Do not confuse this with the damage left from sunburn.]



Sometimes a black rot will attack the apex and produce a weeping black slime. If this does not dry up within a day or two, or appears to be spreading, cut off the top of the plant down to healthy tissue. If it reaches the vascular bundle in the core all bets are off.



If not addressed adequately the resulting spread of the blackness can penetrate through the heart of the plant within surprisingly few days. This normally only occurs in plants with (one or more of): too little light, excessive moisture, overly rich soil or bad ventilation.



Rot may also show up at the base on cuttings that have not been callused adequately or have been wet too long. Remove them from the soil and cut off the slimy section until only sound healthy tissue is present. Allow to dry for 5 to 7 days in a dry place out of direct sun before replanting. Powdered sulfur seems to help if rot is recurrent. Savlon or Betadine both can work if extreme measures are needed.



A common basal rot on cacti is orange and/or olive colored, sometimes it is a light brown, this should be aggressively removed or it will spread. It is also **infectious** and can be easily spread by a contaminated knife, pots or soil. Do not reuse soil from plants affected by 'orange rot' or you will often see it reappear.

Use of Consan 20 or Physan 20 can help control rot organisms as can soaking cuttings in either one immediately prior to healing or planting them. It won't replace removing rotted tissues before healing.

Most rot in cacti is produced by soil organisms such as yeasts, molds, fungus and bacteria; they literally eat the cactus.

Coreids such as Leaf-footed bugs (*Leptoglossus* spp - see upper right image), *Narnia* species and several other sucker bugs can help spread rots when making punctures for feeding.

Another thing that is occasionally encountered in Peyote is development of what ANDERSON 1980 calls a brownish corky layer. This is unsightly but doesn't appear to harm the plant. It can cover the entire body but usually is present as large diseased looking areas growing from the outer edges inward. ANDERSON states that it is not natural and is seen in some greenhouse grown specimens. The cause is not clear.

An odd spreading tan scarring that can appear on *Trichocereus* and other cacti. The cause or a treatment is not known to this author.

Mealy bugs (*Pseudococcus maritimus* and *P. citri*), and, most especially, root mealy bugs (*Rhizoecus falcifer*) can be a major problem. These latter pests look like cottony patches on the roots or in the soil.

They will rapidly take over a collection so immediate and aggressive action is called for. Spraying the plant will not do much except kill exposed insects.



Some types of insects with ova depositors will lay eggs inside of Pedros. The only recourse, other than exploratory surgery, is to destroy (or use) the plant before they emerge or else to use a systemic insecticide which will permanently leave the plant unfit for ingestion. Look for small pale sunken patches on the skin with one or two small holes which look like pin pricks. There will be few, if any, outwards signs of the intruder until the cactus is noticed to be hollow and slime filled. They will stay green on the surface until almost completely hollow. Often the base will start to yellow first.

Cactoblastis cactorum, a cactus specialist moth, also targets cacti, especially if soft bodied. It lays its eggs on the plant, which its larvae then burrows through for nourishment. While usually not directly fatal, plant death often results from secondary infections that spread through the excavations; rotting the cactus from the inside out. Use of systemic insecticides will prevent this activity but surgical excision is required to save affected plants. Not only the intruder but any areas of rot or compromised tissue must be removed. Often there is no signs of the intruder except for occasionally small amounts of droppings on the apex.

Other larvae that burrow also need a similar response.

An interesting observation that bears further investigation is that cell cultures of a *Cephalocereus* species were found to be stimulated to start producing compounds highly active against rot producing yeast and bacteria when the cells were exposed to chitin (the structural component of insect exoskeletons).

Despite the variable coloration these are nymphs of the "cactus bug" *Chelinidea vittiger*



Chapter 7: Pests

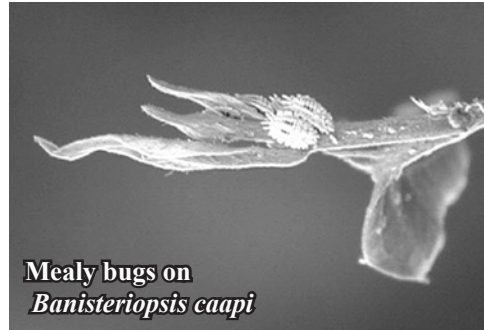
The best recommendation is to uproot the plant and destroy the soil like the infectious material it is. Destroy the pot or else soak it in a 50% bleach solution before scrubbing it clean. Take the plant and wash the roots bare and clean under running water, into a drain not your yard, using a soft brush. Remove any roots that are necessary to facilitate this. When done, allow to dry for a couple days and replant. Drench both the soil and the plant thoroughly with insecticide immediately after planting and keep segregated from the rest of your collection until you are certain they are under control.

If this is not feasible, spray the plants and **thoroughly** drench the soil by watering with Merit™ [Note 14], Malathion™, Diazinon™ or, less effectively, nicotine [Note 15] (Blackleaf 40™ or a freshly prepared strong tea of *N. rustica*) in a soapy water solution. Repeat at 10-14 day intervals for two months. Keep checking the soil as root mealy bug eggs can lie dormant for up to several years.

They are normally spread by ants which ranch them for honeydew much as they do aphids. Controlling ants will go far towards preventing and controlling mealy bugs and a number of other ant-farmed pests. Diatomaceous earth can be helpful (Soil incorporation of diatomaceous earth, as an additive.) [Wear a good dust mask (P100 for submicron sized particulates) when working with diatomaceous earth or Perlite; NOT a cheap nuisance particle mask.]

SCHUSTER 1990 recommends regular feeding with systemic insecticides and incorporation of paradichlorobenzene crystals into the soil mixture to discourage them.

Regular repotting will help ensure detection before they get out of hand. Scattering mothballs or broken mothballs in with the rocks on the surface of the soil will also help minimize a variety of pests but must be replaced as often as they evaporate.



Also, a useful trick to discourage soil pests is to add around a teaspoon of Ivory Liquid per gallon or two of water every time they are watered. This not only kills or severely stresses insects and their larvae but will also act as a surfactant (wetting agent) and makes the water, and nutrients, if fertilizer is present, more readily available for the plants to absorb. It will not hurt the plants. It will facilitate wetting and delivery of insecticide, especially if the soil is dried-out.

David GRISBY, writing in the *Cactus & Succulent Journal* mentioned that an insecticide manufactured by DOW Chemical and named Korlan 24E™ is miraculous for eliminating root mealy bugs. Watering plants with one tablespoon per gallon is said to produce fumes which fumigate the soil and kill the mealy bugs. We have not used it and do not know if it is safe for use on food crops.

Mites and thrips can also be pests, especially with globular cacti such as *Gymnos* and can rapidly disfigure a collection. A good miticide or insecticide will respectively eliminate them but may require repeated treatments.



mealy bugs (top); root mealybugs (bottom)



Dactylopius on a *Trichocereus*. After molting. White hair-like structures are filaments of wax.



Dactylopius sp. probably *D. coccus* in Hays County, Texas

Cochineal infestation of an *Opuntia*. This mealy bug has been used as a ‘biological control’ of *Opuntia* species.

Prior to the invention of synthetic dyes these were raised for production of a carmine red fabric dye.

It is still used to produce a nontoxic colorant found in foods, beverages, cosmetics and pharmaceuticals.

Chapter 7: Pests

GRISBY also recommends that Sevin™ or Malathion™ be used for fighting scale, small bump-like creatures which can be scraped off with the fingernail.

These are only a problem if ignored and allowed to spread. They only seem to affect a few of our plants, and are *usually* more of a problem with the low globulars than the columns. We have them show up on a handful of plants every few years and one or two treatments with soapy nicotine or Malathion seems to do the trick.

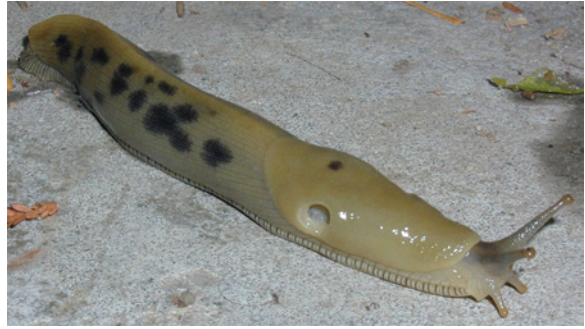


Scale insects; *Opuntia* (top), San Pedro (bottom)

A soft toothbrush and rinsing with clean water will aid in their removal and sometimes suffices for their control.

Scale can also be treated by touching each one with a cotton-swab dipped in rubbing alcohol or a tincture made by soaking tobacco leaves in alcohol (ethanol or isopropyl). The alcohol permeates the scale's protective coat and permits delivery of the nicotine. Isopropyl alcohol is itself toxic but nicotine works much better. Stay aware that nicotine can be readily absorbed through the skin in fatal amounts.

Slugs and snails sometimes eat the tips of *Trichocereis* clean of new growth. Controlling the slug population will eliminate this problem. Snail bait is widely available or else leave out pie pans or bowls half-full of beer. They will be attracted and crawl into the containers and drown (or at least they will still be there in the morning). Discard the contents every morning and be certain that they die in the process. Repeat every night until the traps stop catching slugs. This really works.



Banana slug (top) & slug damage on cv. TJG (bottom)

Oil sprays are frequently and effectively used on many plants for a number of the insect pests we've been discussing. **These type of sprays should NEVER be used on any type of cactus.** (Products like Dormant Oil Spray etc...) The oil in the spray will dissolve the waxy protective outer layer of the plant, leaving it vulnerable to solar radiation, burning and drying, often disfiguring it, frequently just killing it outright.

Pill bugs can do a lot of damage to cuttings or other less than established plants. They often eat cactus from the ground up leaving an empty husk of skin and spines.

They are difficult to control but pill bugs will not bother healthy plants so optimizing the plant's health is the best solution.

Nematodes can be a problem in some areas. Usually Pedros will adjust and not suffer too much damage, except to the odd plant. In one of his 191 *CSSJA* "Cactus Patch" articles on insecticides and fungicides in cactus, David Grigsby stated that a product named Nemagon™ is sold for use on living plants but that he could not tell how good of a job it did. He mentions that a mold found in manures kills nematodes and that the incorporation of manure into soil eliminated a known occurrence of nematodes.

Nematodes really do not like soil which has a high manure content. Adding urea and sheep manure to gardens with nematode problems will help control them.

We have seen friends nearly eliminate severe nematode infestations in large gardens by the regular spreading and forking or hoeing in of composted manure. Both cow manure and turkey manure seemed to help markedly.

The professional recommended approach when discovering nematodes is to destroy the plants, (and if container grown, the soil and the pots) and use a soil sterilizer like Vapam™, which requires that the soil be aired out for a month before new plants are placed in it. This is not always an option.

Clandesan™ is a uric acid rich commercially available crab shit that works wonders. Recommended application is when no plants are growing in the soil to avoid burning them. In emergencies, the possibility of burning a plant which is faced with otherwise certain death is not an important consideration. It does not eliminate them but definitely makes a noticeable difference.

In the article mentioned above, D. Grisby mentions that a neighbor of his took an *Echinopsis* found to have root knot nematode and after cutting off half of the roots placed it in a manure mixture. After a year or so, when he dug it up for inspection, he found no nematodes on the extensions from the nematode infested roots and none on the new roots formed where the original ones had been severed. This suggests that removing nematode infected portions and rooting the remainder in a manure containing mix may be of usefulness.

The biggest problem with nematodes is the risk of getting them in a container grown collection. I suggest taking whatever steps are necessary as early as possible to avoid major headaches. I have been told that there is a “beneficial” nematode that will eat harmful nematodes but know nothing about it. I have been fortunate enough to have only lived a couple of places which had nematode problems.

A recent publication by ANDERSON 1998 can provide a more in-depth discussion of cactus pests.

On the subject of insecticides, **almost all mainstream commercially grown plants can be expected to have high concentrations of systemic insecticides and fungicides.** These plants are not safe for ingestion. This is, for the most part, not done out of malice but simply to help minimize fungal and insect originating losses and maximize returns in commercial scale propagation operations. Seedlings and adult plants can have their growth rate artificially enhanced by lightly overfeeding when taking this approach and hence increase profits.

It is recommended that several generations of cuttings be allowed to elapse before the stock is actually used (its descendants being used rather than the original). This may be overly cautious; many systemics break down within several years.

The contaminated plants can still serve as nice specimens or sources of cuttings for propagation and grafting.

Better still, only buy from a reputable and responsible grower who knows what is done with these plants and either used only biologicals or else non-systemic insecticides.

It is known that some commercial growers have deliberately used systemic pesticides on San Pedros in the misguided idea that in doing so they will discourage people from eating them and thus protect themselves from possible legal problems for selling the cactus.

It is not illegal to sell or cultivate this cactus. **Intent** to use for drug purposes, possessing a mescaline containing solution of processed cactus or actually using them for drug purposes are against State and Federal Law. Selling them intentionally for drug use or as drug plants is also illegal. This implies that selling them, even if treated with insecticide, and believing that they are intended for drug use is also illegal. Selling them for horticultural purposes is neither illegal nor is it restricted in any way.

Notes on Cultivating Some Other Cacti

Most cacti will thrive with watering only once a month the warm months and none in winter. During hot weather they can be watered once a week or if very hot every day. The soil should dry out between waterings. If they start to go soft or look “funny”, discontinue all watering until once again robust. In general, cacti should not be watered when it is cool and they should be enabled to go through winter in a very dry state.



Ancistrocactus scheeri



Ariocarpus

Easy to grow if not overwatered.

Younger plants, such as are available as seed grown material will handle and enjoy much more water than old plants especially if they were originally field collected.

While they can and do handle heavy watering in the hottest part of the year; they are more likely to survive for long periods with less water than more. Their natural home is very rocky; water is neither readily accepted nor retained.

MARTIN *et al* 1971 recommend freely watering from April to October.

In my experience, *Ariocarpus* do respond well to regular summer watering but have shown a high death rate the following winter. I should add that this is NOT the experience of my friends in northern California who insist that normal watering is required for healthy *Ariocarpus*.

My friends in northern California have excellent results as can be witnessed by their *Ariocarpus retusus* specimen pictured below.

I am at a loss to understand the disparity but suspect our very different environments may play a role. Our friends grow them in a *greenhouse* where they get higher temperatures and protection from rain and dew. It could also involve the excessive number of molds and fungal species that grow here (in Texas) during cool weather. Our friends in northern California report little problem with mildew and rot on cut cactus surfaces which is in complete contrast to Central Texas. (Our water and soil are also very different.)

They need to be very dry going into winter and can handle mild freezes in most cases. Some of them (especially the longer succulent leafed and southern forms) are less cold tolerant. Their soil should be coarse, mineral rich (especially high in gypsum and lime) and contain more gravel and rock than normal. They are slow growing plants and susceptible to many soil borne pests in moist soil.

While they can usually tolerate full sun (and do often grow in open rocky areas), they do best when sun is restricted to part of the day. This is especially true of the longer leafed forms.

Most have taproots and will appreciate an appropriate pot.

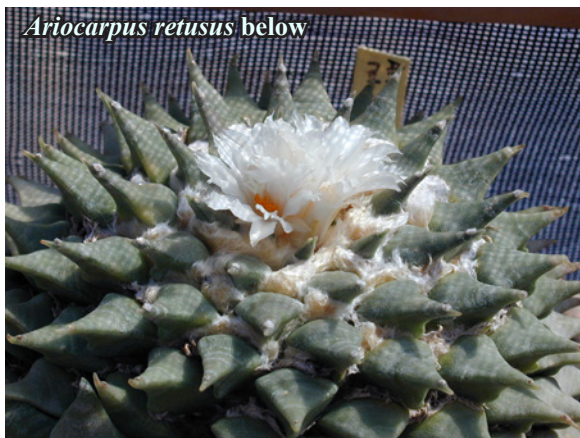
MARTIN *et al* 1971 also recommends repotting every year as a very open compost soil is rapidly depleted of nutrients, to provide a yearly check to prevent mealy bugs from infesting the roots and to prevent having to break pots to repot the plants.

They are easy from seed but watering needs to be decreased when they get around 1/4 inch tall. They still should not be allowed to dry thoroughly until they take their full form (usually one to two years.) Misting should be less and slightly less frequent than normal during their first year. Some such as *Ariocarpus (Neogomesia) agavioides* are amazingly easy to grow and can reach their full adult size (always small) within a few years. Most grow much slower. Many take decades to reach any size. Large plants can be ancient.

They often have very nice flowers, some species have white or yellow flowers but many are an intense rosy-violet. The sight of an old wild *Ariocarpus fissuratus* in full bloom, its rosy petals edged with white, causing them to appear almost as if glowing, nestled under freshly rained on resurrection plants is a sight not soon to be forgotten. Most flower in mid to late summer.

They do not transplant well, especially if large and old. This is true of many wild cacti. The best philosophy with wild cacti is, "Take only photographs; leave only footprints."

MARTIN *et al.* 1971 made the claim that large concentration of alkaloids are found only in "healthy, actively growing plants" but do not include the reason for their conclusion.



Ariocarpus retusus below



Ariocarpus fissuratus
seed-grown



Ariocarpus fissuratus Big Bend National Park
Photo by Suzie above



Astrophytum coahuilense X *Asterias* X Superkabuto

***Astrophytum* species**

Treat like *Ariocarpus*. Lots of sun. Soil must be coarse, well draining and be either neutral or slightly alkaline. Smaller plants are more tolerant of water than *Ariocarpus* but, if they are large and old, infrequent waterings will substantially prolong the life of these magnificent specimens. Many people graft *Astrophytum*.

Young plants, especially seed grown, will tolerate more water than old plants and can be treated like a normal cactus.

For all, dryness in winter is imperative unless kept indoors in heated air.

Many are cold-tolerant or even mild freeze hardy in the wild but all should be protected from hard-freezes in cultivation.

The beautiful white dot pattern on the surface of *A. asterias* and others is easily destroyed by touch, handling or abrasion. It does not grow back.

Using wooden or bamboo tongs to grasp by the top of the roots will aid in retaining the markings on loose plants through transplantings. They grow rather slowly but seem to appreciate occasional feeding. *A. asterias* is more water tolerant than most and grows fairly rapidly in cultivation.

Very interesting looking *Astrophytum* hybrids exist.

Astrophytums are often grafted to promote both pupping and speed of growth.

Aztekium ritteri

Needs less water when young and free watering (if well rooted) during hot weather when mature. They should be treated like any other finely seeded cactus but will need slightly less water. Water cuttings with great caution until established. They will need dry conditions during winter and can generally survive subfreezing temperatures if dry. [PIZZETTI states they will not tolerate cold. I have seen bed-grown specimens tolerate 6°F when totally dry. Watering was discontinued in August and protection from rain erected.] Several sources, including the Lambs, recommend soil consisting of half powdered or crushed slate and half sand to mimic their natural habitat. Miles Anderson 1998 made the claim that they “grow only on pure gypsum in the wild”. MARTIN *et al* 1971 describes their native habitat as almost inaccessible cliffs.

A soil that is coarse, fast draining and mineral rich is also acceptable. Handles full sun but does best if part day. Full sun may be required for good flowering. Occasionally these will form clusters when old but they often remain solitary.

We came across one horticultural literature reference mentioning they contain caffeine but we have not located any confirmation. (Nor, confirmation on the reports of caffeine in ANY other cacti.)

PIZZETTI mentions that grafted specimens stay green and do not become as attractive as when rooted.

This rare endemic should never be wild collected.

Colorado mesa-grande

Likes a loose powdery soil with a lot of lime and very little water. They can easily handle hard freezes if kept dry. They are considered a *Sclerocactus* by some and exhibit the same sensitivity to overwatering *Sclerocacti* are famous for.

They can handle full sun but normally grow where they get some degree of partial protection. This is a slow growing miniature that is need of greater propagation. It occurs on the southern slopes of Mesa Verde National Park and north of the park and west to Shiprock Mountain in the ‘Four Corners’ area.

Seed may need stratification for good germination.

An interesting technique used successfully by Richard MAY 1980 for difficult to germinate *Sclerocactus* is to periodically moisten the seeds (on a bed of native soil) and expose them to direct sun, for two months before planting.

Another technique used by Mr. May for raising very moisture sensitive cacti is to place clay pots containing the plants into a bed of sharp sand, (sinking them to a level nearly as deep as the soil level in the pots), which has a thin bottom layer of bank sand or similar clay containing soil (not contacting the clay pots) to retain moisture. All watering is done into the larger tray and moisture allowed to reach the plants only indirectly by evaporation. That this works even in the excessive humidity of Houston bears testimony to its effectiveness.



Astrophytum cv. Superkabuto

Steven BRACK has pointed out that the biggest problem with *Sclerocactus* species is that they can not tolerate any prolonged periods of high nighttime temperatures. He recommends keeping them in a refrigerator at night during the hottest part of the year. Most people trying to grow *Sclerocactus* in unfavorable climates eventually give up.

Coryphantha species

Very rot prone and sensitive to overwatering. Most are cold tolerant only in their native habitat. Many species do not transplant well. Some are extremely easy to grow.

A good rule of thumb with *Coryphanthas* is that if you can easily see all of the skin of the body then the plant will appreciate having full sun for only a few hours a day and partial sun or shade the rest of the time. Some fleshy bodied species like partial shade all of the time. These sorts usually grow under other plants or next to clumps of grass or large rocks. They also tend to be found on hillsides or sloping ground, often in very rocky, generally poor soil. [Related plants like fleshy bodied *Dolichotheles* can thrive very well even in indirect light. We know of one person who wild collected some many years ago and then forgot about them, leaving them closed in a paper bag over fall and winter with no loss. (Those with tuberous roots either need deep pots or to be planted in beds.)]

Species of *Coryphantha* which have most of the flesh obscured by spines do better if they can have sun all day long. These tend to be more open rocky country plants. Many, as in the case of *Coryphantha cornifera* are found in substantial populations on bluffs and cliff faces in rock cracks and pockets of soil. Populations usually seem to be highest towards the tops of the canyon or bluff walls. Distribution of individuals suggests they are spread both by water and by birds enjoying their fruit.

Cactoblastis, a cactus specialist moth, seems to favor *Coryphantha* species as food for its larvae and several central Texas species have totally disappeared from some areas of former abundance after its arrival. We would suggest use of a systemic insecticide for ornamental specimens.

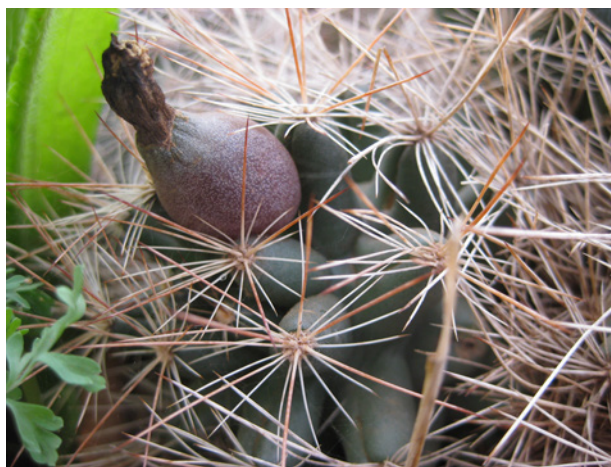
My only experience with sacramental use of these plants (several hundred grams of fresh *Coryphantha macromeris*; i.e. Doña Ana) has been very mild and very strange, with many waves of intense nausea and extremely persistent after effects, such as distorted vision and a very *weird* feeling of unreality lasting for weeks after its use. I will not ingest *Coryphanthas* in the future although respecting them and finding them attractive. For this reason I do not discuss the active *Coryphantha* species in depth. I would suggest that mescaline is not only more pleasant but a far better and more effective alternative without the same level of risks and weirdness.

Edgar Lamb & Brian Lamb 1973: page 411, describe *Coryphantha macromeris* as easy growing and free flowering. They mention it requires better drainage than most other cacti and less than average water at all times. They go on to say that it must be grown under shaded glass or it will become bronze and stop growing. For me, this has only been a problem in these plants when they are not used to sun. Best growth does occur when exposed to partial shade but old plants are not as susceptible to sunburn as younger plants. Many times very large plants seem to prefer more sun. Seedlings (even if fully formed) or young plants of *Coryphantha macromeris* should never be exposed to direct sun.

They readily form clumps and we have encountered sometimes large sprawling patches of these low growing plants blanketing widely scattered areas on loose volcanic gravel piles in Big Bend. One patch was well over 6 feet across. They always seemed to be on the down-watershed side of some scrubby tree and on sloping ground. While many got full sun, the terrain limited it to part of the day only. In New Mexico they can get both markedly taller and larger.

The Lambs go on to speak of the importance of winter dryness for this species as it will shrivel considerably to handle freezing temperatures. We have found this to be absolutely essential for these plants. The only loss we have seen from cold is the tips of one large and very old *Coryphantha macromeris* that was freeze damaged during mid-teen weather. We cut it off and found the center to be healthy. (Half of this, well over half a kilogram sized, plant served as the vehicle for the experience mentioned above) The lower part is still alive and producing new growth.

Normally before winter comes we make a plastic enclosure around these plants and other cold hardy cactus, making sure there is enough air circulation to allow escape of water vapor. If the plants are totally dry when winter arrives they have no problems with the usually mild freezes we get. When spring comes they are unwrapped and watered for the first time in several months. They always seem much healthier and more robust than those which are overwintered indoors.



Coryphantha macromeris

The flowers are around two inches in diameter and vivid pink. The seeds are reddish brown and slightly kidney shaped. This is an easy one from seed and is fairly fast growing if happy. We have experienced germination rates in excess of 90% with a very high rate of seedling survival. Watering must be less than normal once started and misting should be discontinued as soon as they reach their fully tuberled form. These are fairly hardy even when young if watering and sun are controlled.

Coryphantha in general has great flowers with an incredible satiny sheen on the petals. While beautiful they have a rather disgusting nauseating smell. It is thought by some to be toxic and an aid to pollination by slowing the movement of pollinating insects. As with *Magnolia* and *Sophora* flowers, small dead insects will sometimes be found on, in or under the flowers. (personal observation)



short-spined form of *Coryphantha runyonii*

Echinocereus triglochidiatus

Easy to grow. It likes mineral rich, fast draining soils and full sun for at least half of the day. [They thrive in very hot rocky areas.] Watering should be deep and infrequent. It often grows in cracks and small pockets of soil in very rocky, often granitic, areas. Keep dry in winter for best health.

They are easy from seed and form beautiful and majestic small clumps which can be divided and rooted. They usually are free flowering with beautiful red flowers.

This species has variously been reported to contain N,N-Dimethyltryptamine (DMT) or 5-MeO-DMT. This is in error.

The confusion in the popular mind appears to have begun when SCHULTES & HOFMANN mentioned the presence of a tryptamine derivative in *Plants of the Gods* 1979: pages 42 and 75, and its possible identity as 5-MeO-DMT in their *Botany and Chemistry of Hallucinogens* 1980: page 192. They based their information on personal communication from Jerry L. McLaughlin to Robert Bye, Jr. (see BYE 1979), that preliminary studies showed a tryptamine derivative, possibly 5-MeO-DMT, to be a possible component of this cactus; at that time cutting edge information. It was portentous news as no cactus had ever been found which contained tryptamines [Note 17].

Always ahead of the rest [Note 18], SCHULTES & HOFMANN published this stating it only to be a possibility. This has gone on to assume a factual status for some people.

When McLaughlin's group completed their analysis, they found that what they could isolate and identify was not a methylated tryptamine but in fact was N,N-Dimethyl-**Histamine** [Note 19]. Their results were included in MATA & McLAUGHLIN 1982 [citing FERRIGNI & McLAUGHLIN 1981; Unpublished results] and also in FERRIGNI *et al.* 1982 [Note 20].

In FERRIGNI *et al.* 1982 they reported observing several Ehrlich reactive spots during analysis but were unable to isolate them for identification. Their opinion was that they were present in only trace amounts and were too unstable to survive their isolation procedure. If the latter was the case it would suggest that both DMT and 5-MeO-DMT can be eliminated as candidates as either one would have been readily recovered by their isolation approach. Please note recent observations of Shulgin footnoted above.

For some reason, while the word of **DMT** being in this cactus *continues* to spread, this correction has not.

(There is also a reference to the presence of 5-MeO-DMT in DIAZ 1979 on page 90 and a typo on page 58 of SCHULTES & HOFMANN's *Plants of the Gods*, which states that DMT,

N,N-Dimethyltryptamine, has been listed to be in *Trichocereus terscheckii* but that should read N,N-Dimethylmescaline.)

The account grows even more convoluted as it appears certain that BENNETT & ZINGG's plants were *Echinocereus coccineus* rather than *triglochidiatus*. See **Endnote 20** and also *Cactus Chemistry*.

Epithelantha micromeris

Extremely sensitive to overwatering, algae, fungus, mealy bugs and nematodes. Wild or old plants frequently do not transplant or root well.

They require good sun exposure, dry air and infrequent watering. They need perfect drainage, soil that does not retain moisture and very little water ever (this latter point cannot be stressed too much). They do not like high humidity.

Soil should be very loose, mineral rich, high in coarse sand and rich in lime. [PIZZETTI 1985 recommends 20% lime.]

They are extremely easy to start and grow from seed. While seedlings grow fast at first, they will soon slow to a crawl and once adults remain very slow growing.

The seedlings are sensitive to encrustation from heavy salt or mineral deposits from water or soil and also support algae growth very well, due to their fine dense spines. Both will cover the plant and stunt it or worse. We recommend distilled water be used for misting.

The dense spination serves to protect the plant from direct sun. Because of the decreased light levels which actually penetrate to the body, any plants with a similar degree of spination will require full and lengthy sun exposure for good health. (This includes hairy white cacti.)

While clumps are frequently encountered in nature, they are rarely seen in seed grown plants. The reason for this is not clear.

This is an extremely popular plant that is currently in serious danger due to overcollection. [Worse, as mentioned above, because very few wild transplants live for any length of time. Cuttings from wild plants rarely take unless grafted.] We feel they are very powerfully sacred plants which should be left in the wild. While sacred, they are NOT hallucinogenic plants. This is an error arising from a misunderstanding of their use. Not all sacred plants are hallucinogenic.

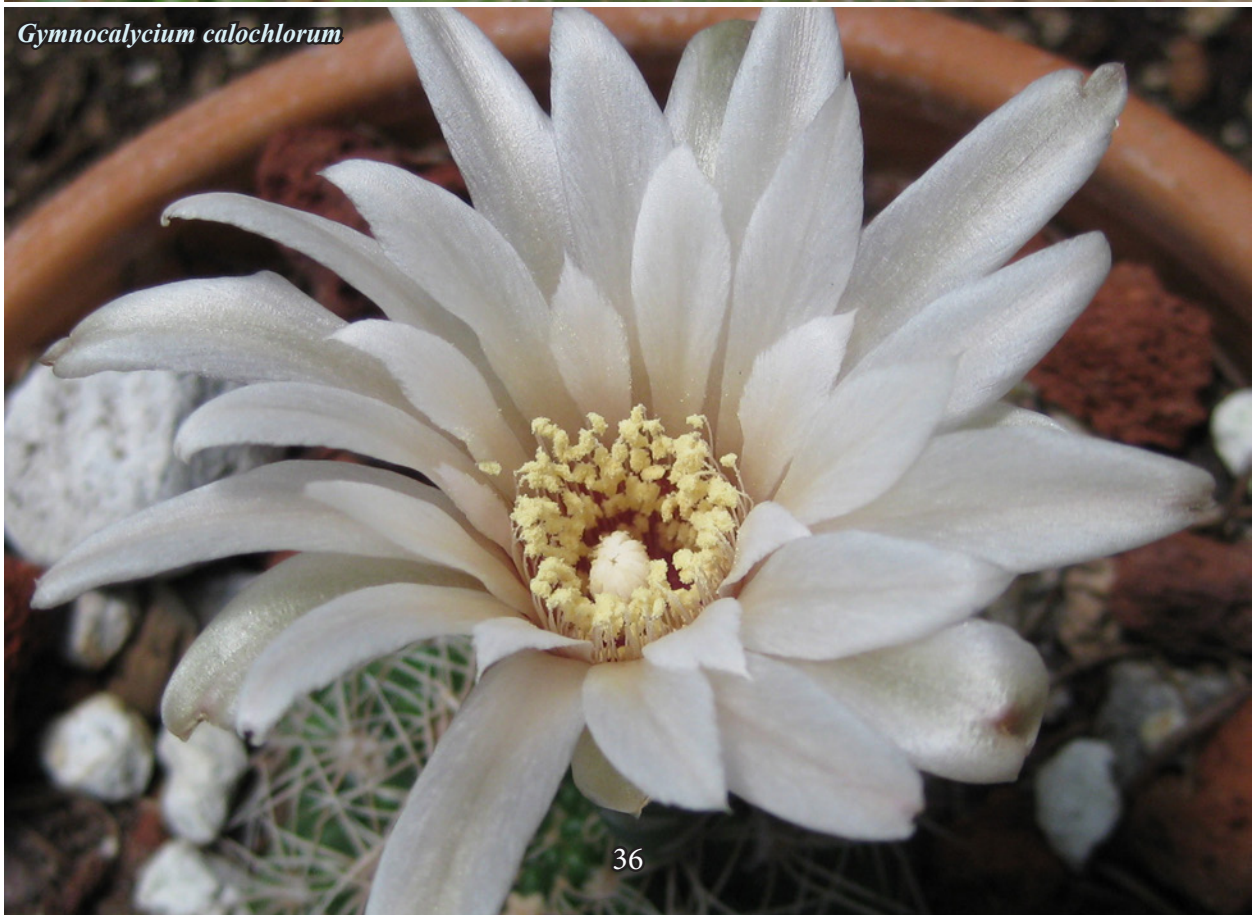
To diverge for a moment, some years ago someone stole an extremely large and very old monstrose specimen of *Epithelantha micromeris* from the Exotic Collection, by rudely hacking it in two. Due to the rough nature of harvest the Lambs thought it was stolen for consumption. It is unlikely it would have lived and rooted from this treatment.



Echinocereus triglochidiatus



Echinocereus enneacanthus



Gymnocalycium calochlorum



Epithelantha micromeris

Forget for a moment that these plants are not hallucinogenic in any true sense of the word, the magnificent plant which was so mutilated was thought to be well in excess of several hundred years of age. People need to think of the age of plants before they harvest them. (They also need to think about the difficulty that the plant had in reaching its size and the high unlikelihood that it will survive captivity.)

The fact it was **STOLEN** was bad enough, but for a plant to live to such an age and see its life wasted on the basis of bad information is an even greater tragedy.

Even if picking peyote, it is our belief that the largest and oldest of plants should never be touched. The largest and oldest plants by their nature are always the best parents for the following generations.

Another related issue is botanical gardens. People often are careless about stealing cuttings or seeds. Many times botanical gardens wind up lacking the seeds they use in seed exchange arrangements with OTHER botanical gardens. Crude or ill-timed harvests can result in injury that open the plant up for rot or other disease. Some times multiple people steal so many cuttings that the plants themselves have trouble surviving (and often don't).

Stealing from botanical gardens is stealing from all of us. It is also stealing from the future and the children who, if the laws continue to escalate, may someday view these as important genetic resources. Most gardens (if not all of them) hold annual or regular plant and seed sales. We hope some day all people can grow enough to respect botanical gardens as the sacred sanctuaries they are intended to be.



Trichocereus pachanoi

Intended for public display but cuttings are stolen so often it stays around knee high or less

***Gymnocalycium* species**

Will turn tan to orange at the base if they are watered too much. It usually forms a permanent scar. *Gymnocalyciums* in general seem to be more tolerant of cold weather than *Trichocerei* but health of the plant is always the biggest factor.

LAMB & LAMB 1971 mention *Gymnocalycium gibbosum* is not a fast growing species but is cold hardy provided it is dry. PIZZETTI 1985 notes that while cold tolerant it will not stand frost. When living in Texas they did not like the high nighttime temperatures. When moving to California they did great so long as I protected them from hard freezes during rainy periods. Some like *asterias* did not tolerate being wet when cold and scarred badly while others like *achirasense* did not seem to mind being left out all winter.

These species require less than average water unless the weather is hot and should not be watered from autumn to early spring. They require a well drained soil. (LAMB & LAMB 1971)

Sun requirements are highly variable but most enjoy at least half a day of sun. SCHUSTER 1990 recommends a winter rest, a semi-shaded position on the cooler side of the greenhouse and plenty of water during the growing season. PIZZETTI mentions that their native habitat (pampas) are quite hot in the summer so they require sun.

Sun requirements, water tolerances and cold sensitivity vary widely within the genus.

We would suggest determining their maximum sun tolerance by carefully working them into as much light as they can handle (over a period of time) while keeping a sharp eye out for sun stress.

In general, they grow readily from seed or clumps can be divided and rooted. They also perform well as grafts.



Gymnocalycium pugionacanthum

Islaya

Requires very good drainage with a soil consisting of 2 parts grit to one part humus. They need less than average water and "top shelf position in the greenhouse". They can take full sun once they are several years of age but are said to flower just as well under lightly shaded glass. Requires total dryness and a 45°F (8°C) minimum in winter. (LAMB & LAMB 1978: page 1293.) SCHUSTER 1990 states they are often grafted; as older plants may be difficult to keep on their own roots. PIZZETTI 1985 describes them as very slow growing. She recommends grafting as soon as possible to speed growth.

In their native habitat they live in coastal areas that receive no rainfall and depend on entirely on mist carried by the wind. Roots are quite shallow to take advantage of this.

MARTIN *et al* 1971 recommends spraying them on sunny days and providing as much light as possible.



Gymnocalycium multiflorum

Lemaireocereus and similar species.

(*Armatocereus*, *Carnegiea*, *Machaerocereus*, *Marginatocereus*, *Pachycereus*, *Polaskia*, *Pterocereus*, *Stenocereus* etc...).

Except for *Machaerocereus* all are moderately easy. All are slow growing. The cuttings of many are slow to root. They require good sun exposure, excellent drainage, moderately poor soil and much less than average water. They will perform best if in an area that will allow outdoor cultivation in the earth. Free root run will be greatly appreciated. They are not recommended for areas with high humidity or air pollution. Cold sensitivity is highly variable but all should be protected from freezing in container cultivation. [*L. beneckii* is one of the most awesome in appearance but needs warmth in winter.]

Machaerocereus eruca needs additional sand in the soil, lots of sun, careful watering and should be planted prostrate to accommodate its natural creeping habit. MARTIN *et al.* 1971 describes its successful culture in a meter long narrow box in a greenhouse. It is said to rarely flower in cultivation and to be slow to root.

The similar *Lophocereus* species should receive lots of sun only if they are used to it or they will scar horribly; partial sun is better. Despite their Baja origin, these tend to grow in canyons and ravines and thus need rather rich, sandy soil, very regular watering & winter warmth.



Machaerocereus eruca

Mammillaria

Easy to grow. The more ornamental species require a slightly richer mix. Many thrive with additional granite sand. Low growing forms often need deep pots for the usually present taproots as well as very good drainage. Due to their wide range of distribution and habits, watering needs are highly variable as are temperature and light tolerances. They are normally very freely flowering and set seed readily. The complex of plants similar to *M. heyderi* will do best if additional rock such as decomposed granite is added, and watering only moderate. They are often found in open sun but those with some degree of protection get far larger and appear healthier. (*Mammillaria hemispherica* needs more water and partial sun.) They thrive under arid harsh conditions. This is also true of *M. grahamii* and var. *olivae*, which we have usually encountered sheltered from all but a few hours of direct sun by bushes or rock formations.

Hairy, white *Mammillarias* require lots of full sun and are extremely sensitive to overwatering. They can die almost overnight. In this latter case we suggest they be watered like *Ariocarpus* or only if in obvious need. (as judged by visible shriveling.) Most hairy white *Mammillarias* are cold sensitive below 45° F in cultivation.

For hairy or densely spined ornamentals, either break or cut their pot to get them free for transplanting, as dirt and gravel can mar their appearance.

Mammillarias are usually easy from seed and not only flower prolifically but can become abundant seed producers as older specimens. Many are fast growers and clump readily.

No *Mammillaria* is yet known to contain hallucinogenic alkaloids. They are often considered sacred plants (I agree wholeheartedly) and some are known to contain mild stimulants. The careful reader will find numerous statements in the literature which directly contradict me. In no case will the reader find a meaningful reference included that supports the assertions of hallucinogenicity. We will bet that they will never encounter bioassay reports accompanying or supporting the claims.





Mammillaria chionocephala



Mammillaria sp.



Mammillaria theresae

Chapter 7: other cacti

Mammillaria heyderi MUEHLENPFORDT was reported by BENNETT & ZINGG 1935 to have ethnopharmacological applications among the Tarahumara.



Mammillaria heyderi

This report has led some writers to assert that it is a hallucinogenic cactus and others to further extrapolate its purported action to the presence of N-Methyl-DMPEA reported in BRUHN & BRUHN 1973 (despite this never being demonstrated or even expected to be a hallucinogenic alkaloid.)



Mammillaria craigii



unlabeled *Opuntia*

If the accounts are read carefully the *only* support for this alkaloid being hallucinogenic is its presence in this cactus and the assertion of hallucinogenicity for the species. It is noteworthy that this claim is always made by people who have never actually ingested the cactus or the alkaloid.

The actual identity of Bennett & Zingg's cactus was determined, in BYE 1979, to actually be *Mammillaria craigii* LINDSAY. Inexplicably, Bye's correction has largely been ignored.

M. craigii lacks any analysis. Human bioassays of large old specimens in Australia have reported it as having a euphoriant to MDMA-like action rather than a hallucinogenic one.



Obregonia denegrii

Obregonia and *Pelecypora* spp.

Treat like *Ariocarpus*. More tolerant of water but not as cold hardy in most cases. Watering should still be only moderate and fairly infrequent (monthly intervals); being certain of drying in between. *Obregonia* needs partial sun although full sun is recommended by some growers. *Pelecypora* loves sun once past the seedling stage. Both need lime, dry winters and minimal watering the rest of the year. Both grow readily and easily from seed. SCHUSTER 1990 states they are impossible to graft but we have witnessed successes for both.

Opuntia spp.

Stick them in the ground and watch them grow. Seriously. There is wide variability in their water requirements and sun requirements. Most like full sun and plenty of water when hot. Many are cold hardy (some living as far north as Canada) but it is a large genus and contains many frost sensitive species.

There are three main types of *Opuntias*, one has large flat pads, the second long cylindrical stems and the third is usually seen as short globose joints (some looking like stacks or mats of balls or short cylindroid joints.)

The globose species are very sensitive to overwatering. They often are open country or high altitude plants which are happiest with lots of sun and dry air. Soil should be fairly poor. Joints become fragile during cool weather and stacked balls should not be jarred or moved during winter, even if in greenhouse collections. Most are freeze tolerant if dry.

The flat padded species can be partially planted or simply placed on the ground so roots can come out of the underside of the pad. Several flat padded forms lack or nearly lack spines and are widely cultivated for food. These generally are not hard freeze hardy.



Austrocylindropuntia verschaffeltii

The cylindrical stemmed *Opuntias* (*Cylindropuntia*) can grow into woody trunked trees. Cuttings can be placed in soil and they will root well. However, many species will not form a trunk unless they are seed grown or if the cuttings included a woody section of stem from the parent plant. Most of these will handle freezes into the low twenties or upper teens with no problem. Some, not all, can take colder extremes. Do not overwater chollas.

Opuntias have spines and glochids (tiny tufts of small spines that detach easily). Both have microscopic overlapping scalelike barbs.

Some such as the popular “Cinnamon Cactus” have dense and fine glochids which a careless person can instantly acquire by the hundreds. A useful method of treating such an unpleasant acquisition is to use a hot wax hair removal kit, heating the goop in hot water, spreading it liberally on the affected area and using the pads as per the instructions to remove the spines. Two applications may be needed in extreme cases.

It might be of interest to note that the glochids of at least two species were determined to be composed of pure crystalline cellulose. [MEYER & McLAUGHLIN 1982 cited PRITCHARD & HALL 1976]

This suggests that a plaster containing a high level of cellulase might be of use for imbedded glochids but nothing has been found to support this conjecture.

I have found reference to a solution of gum arabic (from some *Acacia* species) as being of use to treat glochids in the eyes but recommend immediate professional attention be obtained.

The cylindrical stemmed *Opuntias* (“chollas”) have notoriously wicked spines that actually stretch the skin during their removal and leave the tips embedded in the flesh.

Bare skin contact with any *Opuntia* spines or glochids should be avoided if possible. Leather gloves or tongs are recommended. Gloves will eventually be ruined as the spines will gradually work their way through.

Pereskia species

Claimed by some to be the first cultivated cacti due to their use for natural hedging in tropical areas.

Treat these epiphytes like orchids but with less moisture. While soil should tend towards the dry side; they respond well to misting and both moisture and feeding should be greater than for most cacti. Soil should be loose and rich; leaf mulch is a good component. Most are fast growing. All do best if they have plenty of root room.

Some are fairly cold-hardy but most are often cold sensitive around 40° and, while fairly shade tolerant, will show the best growth if in partial sun.

Full sun will shock or burn them if not used to it and at least in my experience even new growth will be much slower than if in partial sun even if they are adapted.

Best propagated from cuttings which root readily (take cuttings in summer). The cuttings should be planted as soon as they are taken and not allowed to callus or they will dry out too much. (Green sections of mature shoots are said by SCHUSTER 1990 to root easily in a sand based mix with bottom heat and high humidity.)

Pereskia often grows sprawling and leggy so some growers root new cuttings for their display plantings as often as this occurs.

SCHUSTER recommends reduced water in winter and diffused light conditions.

Spines can be long and are exceedingly sharp. They often can be hidden by the leaves.

Leaves are said to be deciduous but, so far, I have only observed this during winter on plants that were both stressed by cold and lack of moisture. It is claimed that if temperatures are kept above 45°F they will not drop their leaves.

Even in winter their soil should be kept from totally drying out. In summer, they love lots of water.

These are easy from seed but seeds seem to be rather rarely offered. They fruit readily but viable seeds per fruit are often few.

Peresklopsis species

Treat like *Pereskia*, may need more sun in general, but watch out for tiny glochids. Valuable and frequently used for grafting young seedlings as they are fast growing and stems are small in diameter. If used for grafts they should be replaced every year or two as they will tend towards exhaustion.

Solisia pectinata

Treat like *Islaya*. Needs warmth and good sun exposure once mature. Water cautiously during summer and keep totally dry in winter. Easy but slow from seed. May have encrustation problems similar to *Epithelantha*.

Stetsonia coryne

Easy to grow in a rich well drained soil. Fairly slow. Does best in full sun, but will stay healthy with less. Sensitive to overwatering and/or cold (keep above 45°F). Either or both will cause an orange of the base which is usually followed by basal rotting and death.

According to ANDERSON 1998, larger plants are frost tolerant in areas with less than 24 hours of freezing temperatures and will form dense broad bushy growth if exposed to a lot of sun and occasional frost.



Strombocactus disciformis

Strombocactus disciformis

Easy but slow to grow. Part day direct sun or very bright filtered light. Well drained, light, mineral-rich soil with extra calcium. Plant it flush with the ground. Water infrequently unless during prolonged heat.

Be certain soil dries thoroughly in between but drench it when watering. Keep completely dry during winter and protect from cold. Easy from seed if treated like other finely seeded cactus.

Trichocereus species

A few were already discussed earlier under Cultivation of San Pedro.



***Trichocereus rosei* #1 (= *Trichocereus peruvianus*)**

Soil and moisture requirements are highly variable; as are cold tolerances. They can handle into the 30's without problem. A few can take freezes below 22°F but not most (at least in containers). Cold tolerances are better if they are established in the ground or in beds.

All usually do best with full sun but may need to be introduced to it gradually to avoid burning and scarring.

ANDERSON 1998 notes *T. peruvianus* likes bright light but “suffers” in strong hot sun. This species and related ones do better in cool areas than in excessive heat. They love coastal conditions.

Branching species root rapidly and easily.

Species that do not branch readily can often be assisted by decapitation and/or tip grafting and or Miracle Grow application.

T. peruvianus handles wet winters and mild freezes well (in California). *T. macrogonus* and *T. bridgesii* have also been fairly cold hardy in California but I did not have the same experience in Central Texas. On the other hand, *T. terscheckii* and *T. taquimbalensis* have proven quite cold hardy. (Even wet into the upper teens.)

T. scopulicola is said to be among the hardiest of the potent mescaline containing species but we do know exactly what its minimum temperature is. I'd suggest protection below 22°F.

Trichocereus cv. TJG is known to handle light freezes and some snow with only minor scarring in northern California but apparently is not as hardy in southern Arizona.

High daytime and especially high night-time temperatures are not appreciated by the *pachanoi* and *peruvianus* type cacti.

For all, a moderately nutrient rich, fast draining & mineral-rich cactus soil with volcanic materials incorporated is recommended.

BORG 1937 recommends a stony and sandy soil with leaf mold or manure [or “garden loam sand” and leaf mold] as a soil of choice for *T. macrogonus* and *T. strigosus*.

John BORG also says to avoid calcareous (calcium-rich) soils for *Trichocereus bridgesii*. [I suspect this could be extrapolated to use of high lime water based on my experiences in Austin compared to those in northern coastal California.]

This species will form black rot easily if watering is abundant. This seems to be even more pronounced when considering the monstrose *bridgesii*.

All are easy from seed.

Planting them densely and not separating until decent sized (allowing the plants to physically support each other when small) appears to be a good approach to mass-producing the columnar Trichs.

***Turbincarpus* spp.**

Treat these slow growing miniatures like peyote (like peyote, they need plenty of calcium to flower and do well).

Some are very sensitive to overwatering, while others such as *T. polaskii* and similar love heavy watering during the hottest part of the year if they are allowed to dry out thoroughly in-between.

Most, not all, are cold hardy if dry. I have seen old specimens of *T. macrochele* handle single digits and thrive.

Some turn reddish with full sun. This is not bad.

Most are extremely easy from seed.

T. lophophoroides is said to like alkaline clay soil. Others have stressed the importance of having little to no organic matter in the soil for this species.

In contrast to the easy culture of the other *Turbincarpi*, I have had poor success keeping *T. lophophoroides* alive for more than a couple of years so can offer no further info. The vast majority have died rapidly within 2 or 3 days of obtaining them; regardless of their source or treatment. Some people have noted that since they grow in alkaline heavy clay therefore this is required in their culture but this knowledge has not improved my results. (*T. jauernigii* is considered by some to be a variety of *lophophoroides* but, in contrast to *lophophoroides*, I have found it extremely easy to grow)

Friends who maintain them in greenhouses have no problems with maintaining or propagating them.

Desert varnish

Even though deserts get occasional downpours there is often little true wetting of the main body of wild cacti's roots. Many grow in cracks in rocks, or on slopes, which water runs over and others, in open flat country, sometimes become surrounded by a surface layer of what is known as “**desert varnish**”. This is due to the action of wind and water removing the top surface of soil except for a layer of rocks sealed together with a colloidal mixture of iron-rich clays and fine sand, baked by the sun and hardened by repeated moistening with dew and baking. Water runs across the surface of this and only wets it to a limited degree. By the same fashion, what moisture is in the soil is retained at a fairly constant level.

Cacti and other xeriphytic plants, generally compensate by sending out peripheral and, in some cases, even short-lived surface roots.

Many times cacti are found in poor soil. This is especially true of those growing in the open. However, many times, those that grow in canyons, ravines, rocky cracks or pockets often occur in rather rich soil, locally produced by the accumulation of rotted vegetable matter and/or rodent and bird droppings. Too rich of soil will favor rotting.



Trichocereus terscheckioides

Comments on “other cacti”

Contrary to what some people are claiming (never from their personal experience) 3,4-dimethoxyphenethylamine is not a psychedelic compound. Nor are any of its N-methylated analogs despite a myriad of unfounded armchair claims to the contrary. Nor are most of the other phenethylamines.

There appear to be some sort of activity in two of the *Pachycereus* species. This area is apparently only beginning to be explored in depth. There is also a possibility that the MAOI action reported for some of the *Coryphantha* alkaloids may enable a hallucinogenic action for other of their contained alkaloids but this line of conjecture is still in need of study. As is Shulgin’s speculation that N-Methylmescaline might be an active molecule if accompanied by an MAOI (such as carnegine in *Pachycereus pringlei*). Careful study of the published literature will show that almost all of the people discussing “other active cacti” have never actually tried the plants that they are purporting to be hallucinogenic. (See *Cactus Chemistry By Species*. for a more in-depth discussion.)

Mescaline is the **ONLY** phenethylamine of natural occurrence that is **PROVEN** hallucinogenic in humans. Some of the *Coryphantha* alkaloids **MAY BE** but this is far from proven. It is certainly true that many of these alkaloids have some sort of activity. Active does not always mean hallucinogenic.

N-methylation IS proven to eliminate hallucinogenic activity from phenethylamines, even such powerful synthetics such as DOM (STP). Any remaining activity is of a stimulant nature. The only *potential* exceptions to this are macromerine and normacromerine. Neither has seen pharmacological testing in humans. Reports of psychoactivity of the *Coryphanthas* are limited, I am the only person I know personally who has actually been crazy enough to

ingest them. The taste was horrible, nausea intense and was both more lengthy and pronounced than with mescaline and the persistent effects were simultaneously mild and weird. See comments in our work *The Cactus Alkaloids* under Macromerine. There is neither the desire nor the inclination to bioassay this plant again.

It must be stressed that due to the unAmerican analog act and the current redefinition of illegality as being based on intent to use for ‘getting high’ or any other ‘unapproved’ use, there is no such thing as a ‘legal high’ (except for alcohol). It exists only as a myth. It is suggested that mescaline is a far better alternative. Legalities are the same, whether using for sacramental or less *bona fide* purposes; effectiveness and safety are both guaranteed and proven. The way the law is currently being interpreted, any and all substances are potentially illegal unless *specifically* told by law that they are not

It should also be emphasized that, with one exception, the law does not recognize sacramental use of plants as valid, permitted or allowed. Apparently the courts in the USA believe that the only religion that is capable of being real and genuine for me is one that is recognized by the state as an established organized religion that was previously invented by other people. The idea that I can experience direct spirituality is rejected. It is also noteworthy that nothing pagan, earth magic or shamanic has found protection in the courts due to not being part of an organization recognized by mainstreamers.

Despite this being religious and spiritual restriction; literally prohibition as proscribed BY THE STATE and in clear violation of the supposed separation of church and state due to the State imposing religiously originating, suggested and supported *mores* and beliefs, the courts do not support or recognize this ancient tradition as being either valid or tolerated for any one other than those of Native American heritage.



cultivated *Astrophytum asterias*
Photo by Anonymous

Chapter 7: other cacti

Even then it is tolerated for no sacramental plant other than peyote; its use being allowed only to those who are duly recognized members of the Native American Church (Membership is not uncommonly limited by racially discriminating restrictions but this varies widely from chapter to chapter; some of which have no racial bias, some of these readily accept any white who is sincere although both the DEA and larger elements of the NAC are attempting to legally preclude their participation based on bigotry and racial bias rather than on their sincerity.) My suggestion is these people might want to reflect on the maxim that unless religious freedom is protected for all it is secured for no one.

There is some evidence that a change in attitude is on the distant horizon but we are presently at roughly the same stage as the Civil Rights movement was in the 1950s. And like the Civil Rights movement, nothing is going to change unless people stand up for their rights. No one else is going to do it for them.

Some phenethylamines such as N-Methyl- β -phenethylamine are moderately toxic and have a decent amount of toxicological work done on them, as it pertains to sheep, goats and rats. Some such as hordenine are somewhat toxic but also of great usefulness [Note 21].

Those few that are thought potentially psychoactive, are usually present in such low concentrations that one would have to process many kilograms of cactus to get a dose. Most rumors and ethnological reports suggesting hallucinogenicity arise from a misunderstanding of native applications and the peculiar and oftentimes erroneous assumption that, if native people use it, it must somehow be hallucinogenic. Their world view is different than many Westerners and does not readily lend itself to such reductionist analysis. “*To widen the eyes and give strength to runners*” is a good example of a misinterpreted use.

We have chosen not to discuss *Epithelanthas* and *Mammillarias* for this reason. We have not tried either of these but while the chemicals they sometime contain may be mild stimulants, they are not hallucinogenic. The claimed enhancement of psychic effects from *Epithelantha* are more probably due to the triterpenes present [Note 22] than to any alkaloids.

I feel that plants such as *Aztekium*, *Coryphanthas*, *Dolichotheles*, *Echinocerei*, *Epithelanthas*, *Encephalocarpus*, *Leuchtenbergia*,

Obregonia, *Ortegocactus*, *Pelecyporas*, some *Mammillarias*, *Tephrocacti* and some of the *Turbinicarpi* are peyotes of a sort but only in the spiritual sense, sort of like peyotes of the ‘little people’. [Some *Tephrocacti* and *Turbinicarpi* may contain usable amounts of mescaline but this has not yet been proven. It was only recently that mescaline was even proven to exist in the *Turbinicarpus* species. See STARHA *et al.* 1999]

I suggest that in the case of *Coryphantha* or any of the other plants just mentioned that they not be ingested but rather that they be learned from by listening to them. This might sound far fetched to some people but let “*those that have ears hear*”. Listening to plants is one of the most valuable things that a person can cultivate.

They do not talk in the same linear format that people do which is why many people miss what that they have to say. When they convey information, it is as packets of soundless understanding coming as discrete units. They also do not shout to be heard.

The most important element of learning to listen to plants and other ‘external’ sources of learning is to learn to distinguish the information from inner thought and imagination by the cultivation of a quiet mind and an inner presence of stillness. Not in terms of sitting with a ‘blank’ mind but rather one of intensely focused listening and watching awareness. (Focusing on the source of pure awareness which is beyond words.) It is amazing what can be learned once we have detached ourselves from the stream of thoughts. It is difficult in the beginning but grows much easier with practice.

Quiet time spent listening to and communing with San Pedro or living fungi is in many ways as rewarding as ingesting them. When listened to in this manner all of these plants just mentioned have the same capacity for projection of presence and teaching interaction. Many others do as well. (*Banisteriopsis caapi* is a particularly communicative plant.)

I suspect it is because of this that many of them are referred to as peyote. Not intending to imply that ingesting them would have the same effects as peyote (they will not) but rather that they have the same presence as peyote and are powerful beings in their own right.

Plants are some of the most important and knowledgeable teachers that exist.



Propagation of *Epithelantha* species in Prague. The small paintbrushes are used for pollination.



Both photos were courtesy of CACTUS CONSERVATION INSTITUTE

Cactus Cultivation Endnotes

Note 1: *Opuntias* start out as a stem with two fine leaves on the end which grow into small seed leaves before the adult form of the cactus emerges from an areole between the two seed leaves.

Note 2: This can be difficult to find but a google search or visit to grape growing suppliers will locate it in bulk.

Note 3: If native soil has a high clay or loam content it will tend to set like a rock when it dries. Add powdered gypsum to it and regularly work it with a fork or hoe for a year or more before use; outdoors, exposed to rain and sun. It will not completely cure the tendency but will help markedly.

Note 4: This originally meant plants with well defined tubercles but ill-defined ribs. European growers sometimes apply it to plants with tendencies towards multiple ribbing. 13 ribbed seems the most common form in large plants.

In the past I was under the impression that *L. williamsii* could form more ribs. I now believe this is from an error I made in believing the identification and purported origin of plants harvested by a friend. I was told they were harvested near Laredo but I suspect this was a ruse to obscure where they had been obtained. I now believe that they were actually *Lophophora fricii* poached from Mexico.

Note 5: The habitat of peyote is being destroyed at an alarming rate. Deliberate root harvests are commonplace in Mexico and USA.

Legitimate collectors are struggling to supply the need of the NAC and incredibly are doing so by harvesting plants too young to have ever flowered (many times less than the size of a dime).

I would prefer to let peyote grow. There are people who still pick peyote. I sympathize with them as they need to pick. But there also needs to be a growing plan. It needs to start now if there is going to be a tomorrow as things can't grow until the seeds are planted. Waiting until the available plants are gone will be too late to take action. How can any species be expected to continue to exist if it is not allowed to drop seeds? I know this is a sacred plant but I can not believe in immaculate germination. Seed production is a requirement for any wild peyote population to be able to reproduce.

Some people do not believe in a future existing. I do. There certainly is a long and well documented precedence supporting it occurring.



Leuchtenbergia principis

Note 6: They seemed to favor *Mammillarias*, often uprooting them and eating all but the spines and skin from the roots inward. They were either unable to uproot or ignored adult *M. heyderii* specimens. They also eliminated all *Coryphantha* seedlings except for the spiny *C. macromeris*. Seedlings of *Epithelantha*, *Obregonia*, *Ariocarpus*, *Turbincarpus* and other Chihuahuan Desert miniatures were also featured heavily in their buffet.

Only a couple of species of *Turbincarpus* seedlings were spared such as *T. macrochele*, *T. polaskii* and *T. pseudomacrochele*. No adult plants of these miniatures were touched except for some *Epithelanthas* which were half eaten. They ate part of a very old and beautiful *Epithelantha* crest.

A curious omission from their feast was *Leuchtenbergia principis*. Even young seedlings were spared. While unidentified alkaloids have been reported, no analysis has been reported for this species.



Trichocereus pachanot



Myrtillocactus geometrizans

Note 7: There is apparently only one published quantitative analysis of the mescaline content for grafted material: 0.93% mescaline was reported by SINISCALCO in 1983. This was far more potent than a heavily watered plant on its own roots (0.1%) but was 1/3 as strong as a plant on its own roots that had been starved for water for six months. In nature, peyote is typically drought stressed for 6-9 or more months every year. This appears to be important for good potency in cultivated plants. A watering strategy that finds a balance of both good growth and potency is the best approach.

Note 8: Many species can be used.

For grafting young plants or seedlings, *Peresklopsis* species are recommended by many due to their small diameter. *Peresklopsis* are used as an intermediate grafting stock only and, when size allows, the graft is then transferred to a larger stock.

Many *Trichocereus* species have been successfully used by growers. *T. macrogonus* is said to be both vigorous and hardy. *T. spachianus*, *T. pasacana* (*Helianthocereus pasacana*), and *T. poco* are also frequently employed, but we prefer *T. pachanoi* due to its minimal spination.

Myrtillocactus geometrizans is frequently used and was said by the late Derek WESTLUND to be the stock preferred by him and other professionals.

Various *Echinopsis* species, *Eriocereus jusberti* and *Opuntia gracilis* (a winter hardy species) have also been recommended by professional growers.

Cereus species are a frequent choice, especially among the Japanese producers and there is some indication that the larger *Cereus* species will stimulate clumping better than most other choices.

Preliminary observation suggests that primary variables may be the diameter & vigor; the larger the diameter, the more emphasis appears to be on clumping. This is an area that needs to be better defined as we can find no rigorous comparative studies on the topic.

Cereus pitajaya, *Cereus pruinosus* and *Cereus tortuosus* were mentioned by FUJITA; we assume in reference to preferred grafting stock but we lack a complete translation of their article.

Note 9: One grower reported it advantageous to use a small wad of cotton on top of the graft to prevent the tape from sticking to his graft and pulling out tufts of hair and/or tender areoles when removed.

Note 10: I usually fold a sheet of typing paper in half, staple it along two edges, open up the unstapled edge and slip it over the new graft like a hat.

Leaving it on for 2-3 days is normally enough time before resuming full sun exposure. but a sharp eye should be kept on the plant the first few hours after removal; watching for bronzing or other color changes indicating sun stress. Some grafts take longer.

Myrtillocactus cochal



Note 11: This can be a very serious problem when watering from beneath. The best way to deal with excessive salt buildup is to minimize it before it occurs. To do this, water the plant thoroughly until water runs out the bottom and repeat this several times. If doing this every third or fourth watering using pure water rather than soluble fertilizer, much of this problem can be prevented.

Obviously this will not work for small delicate seedlings. For these, regular misting with distilled water is recommended.

Note 12: Rootone or Hormodin are common. Both are IBA, i.e. Indole butyric acid, the latter contains higher concentrations and usually is available only to professional growers. If you want it but can't find it ask a local grower to order some for you. They are not to be considered food safe. Do not breathe the dust.

Note 13: An exception being the rare 4 ribbed San Pedro. According to SCHULTES & HOFMANN's *Plants of the Gods*, this form of the San Pedro is thought to be the most magically powerful.

Note 14: Merit is an excellent systemic insecticide but will render plants unfit to eat for 1-2 years after application. It may take a month to work. It also will only work if the plant is healthy enough to take it up through its roots. Aggressively remove the flower buds on any plant treated with Merit to prevent honey bee deaths.

Note 15: An interesting note of little relevance is that *Acacia concinna* which has 2.1 % nicotine in the fresh leaf, is known in China as the "Gold happiness tree."

Note 17: In 1997, Dr. Alexander T. Shulgin thought he had detected extremely trace amounts of gramine and DMT in a yellow-flowering version of the presently ill-defined *Trichocereus grandiflora* but confirmation was never performed.

Note 18: Richard Evans SCHULTES was fully aware that psychoactive mushrooms were in use by the Mazatecs and Otomi as early as 1936, collecting them in 1938-1939, but World War II drew him to the Amazon, allowing WASSON to follow through.

SCHULTES initially identified *Panoeolus campanulatus* var. *sphinctrinus* as being used for divining purposes and published this information several places, such as in the *Harvard University, Botanical Museum Leaflets* in 1937 and in 1939.

Note 19: N,N-Dimethylhistamine was also isolated from *Echinocereus blanckii* (Pos.) PALM. See WAGNER & GREVEL 1982. They believed theirs to be the first isolation of this alkaloid from a cactus. (Previously observed in traces in *Spinacea oleracea* L. and isolated as its picrate from *Casimiroa edulis* LLAVE et LEX. Imidazoles have been reported from several other cacti especially *Dolichothele* spp. Ehrlich's reagent reacts with some of the imidazoles similarly to tryptamines.

Note 20: Using *Echinocereus triglochidiatus* var. *paucispinus* (from near Del Rio, Tx.): Obtained as hydrochloride; listing 0.11% yield by dry weight. but gave 106 mg from 900 grams of freeze-dried and screened plant. (Also detected chromatographically in var. *neomexicanus*.) Effects were said to be similar to histamine.

Human bioassays were reported by an anonymous correspondent who, apparently based on the drug literature available to him, was under the mistaken impression he had isolated crystalline DMT. He could only comment that it made him feel "strange." This person had first bioassayed it by smoking, next ingesting it orally on its own and finally with an MAOI added.

To add yet one more twist to this already twisted story, all of the varieties of *Echinocereus triglochidiatus* that FERRIGNI analyzed (except *perhaps* the *neomexicanus*) as well as **any** of those cacti that would have been encountered by Tarahumar would actually have been a variety of the tetraploid *Echinocereus coccineus*.

Echinocereus triglochidiatus is a more northerly diploid species that occurs in New Mexico and Colorado. See POWELL & WEEDIN for a discussion and details concerning both of those species.

Note 21: Hordenine is found in many cacti, and can be useful as an **external** antibacterial agent. It is active against a variety of pathogenic bacteria including many antibiotic resistant strains of *Staphylococcus aureus* and *Staphylococcus pyogenes*. Its presence in Peyote may help to validate Peyote's age old reputation as a healer of infections and wounds when used **externally**. *In vivo* testing has not shown any significant antibiotic properties when taken internally.

TODD 1969, mentioned earlier, found it to be present only in the roots. Other workers apparently found it in the plant; they were working with dried buttons supplied by S.B. Penick and with greenhouse maintained plants of Mexican origin.

[In studies of several *Mammillaria* species, its concentrations were also found to be highest in the roots.]

Interestingly, McCleary found that peyote had stronger antimicrobial properties than any other cactus that they looked at, some of which have been reported to contain higher levels of hordenine than peyote.

Note 22: Any enhancement of psychic effects (If True, *probably* from the contained triterpenes) would be better obtained from the prolonged use of plants such as *Dendrobium hancockii* stems and buds, *Alisma plantago-aquatica* tubers and *Asparagus lucidus* roots. These plants are all far more quickly growing and readily cultivable. They also are all readily available in herb form or as plants. All are excellent additions to any Chinese tonic herb formula and high quality material is readily available through better Chinese Herb suppliers. [*Cinnamomum cassia* (Chinese cinnamon) bark and *Glycyrrhiza uralensis* (Chinese Licorice) root are good additives for this type of tea.]

References are located in *Sacred Cacti*.

A free pdf containing the master reference list for all four volumes can be downloaded from:
http://www.troutsnotes.com/sc/pdf/Ref_TCA.pdf



Trichocereus pachanot



Gymnocalycium griseo-pallidum



Gymnocalycium megatae



**A crested *Trichocereus shafteri* monstrose
(produced by the original mother at Oasis)
All existing *shafteri* monstrose began with that one plant.**

Excerpted from the current working version of *Sacred Cacti 3rd ed* by Keeper Trout. These words are largely unchanged from the 1997 first edition. Opening comments

"The Archaic Revival is a clarion call to recover our birthright, however uncomfortable that may make us. It is a call to realize that life lived in the absence of the psychedelic experience upon which primordial shamanism is based is life trivialized, life denied, life enslaved to the ego and its fear of dissolution in the mysterious matrix of feeling that is all around us. It is in the Archaic Revival that our transcendence of the historical dilemma actually lies."
Terence McKenna 1992 *Food of the Gods*, page 252.

"Every major advance in science and technology has been greeted with suspicion and alarm. It happened with the telescope; it happened with the thermometer. What we have to take into account is that if any substance has potential for abuse or misuse, then it is axiomatic that this abuse or misuse will in fact take place. There are many people who will be attracted to these chemicals who are in fact the last people who could possibly benefit from them."

"But it's not so easy as all that. The only certainty we have is that whatever we do, it will be rough going. At the end, one of two things will happen: people will say "what an incredible number of blundering idiots there were who thought LSD was of any use whatever," or they'll say "what an incredible number of people there were who were so stupid as to ignore this astounding happening."

Humphrey OSMOND, D.P.M., Director, Psychiatric Research, Princeton Neuro-psychiatric Institute, as quoted in Thomas LYTLE's *Psychedelic Monographs & Essays*, Volume 2

"...I am convinced that we cannot alter the destructive nature of our "Technological culture" without altering our consciousness, without altering our tissue and that is exactly what the psychedelics are for [Note 1]

...In one sentence I can say that the future of psychedelics is the future of the world...the future of mankind. Not only that but the scientific world is making a great, great leap through this altered state of consciousness. It is not admitted because it is an illegal thing, but things Einstein missed have now come into modern physics through the psychedelic doctorates.

[Interviewer: "Fritjof Capra has written that the initial stimulus for the Tao of Physics came through the use of power plants."]

"Not only time but quite a few Nobel prize winners - I won't mention their names, I don't want to mess them up - made their great discoveries after they were turned on. Most of the grand unified field theorists, almost all of them are turned on people."

Baba GANESI, from an interview also published in *Psychedelic Monographs & Essays*, Volume 2.

I understand why people on both sides of this issue might question why I felt it necessary to assemble this book.

Some of those who believe as I do may object to this being written because, while they know the truth, they are satisfied with that and would prefer it be kept sheltered and preserved for them and fellow believers. Those who oppose my beliefs may view this as reckless, irresponsible and a contribution to everything they oppose.

Any forms of spiritual restriction and persecution are wrong. Any legislation of what a person should or should not believe or experience *spiritually* is also wrong. Nor is the truth to be protected from prying eyes and reserved for a select few.

I fully recognize that writing this book under a pseudonym automatically casts at least some doubts about this work's veracity and my qualifications to make some of the claims that I do. What is opinion or subjective observations are presented as such. What is fact has enough documentation included to enable interested parties to decide the truth for themselves by consulting our references, and, better still, THEIR references.

If they truly object to what is included here and what we believe then they should not waste their time reading it. No one showed a gun down their throat to force them to read it. Believers of the systems of worship and spiritual exploration which I discuss, on the other hand, routinely have guns shoved in their face by screaming and often abusive law enforcement personnel, who should be allies and fellow Americans, not sworn enemies, dedicated in their misguided attempts to force us to abandon our spiritual beliefs.

It should be noted that extreme persecution has been applied for over a millennium and a half to people who believe as I do. In many cases, torture and actual death were both prescribed and enacted punishments.

WE ARE STILL HERE.



Peyote plant from Safford 1916



Trichocereus pallarensis
Grown from Ritter's seeds

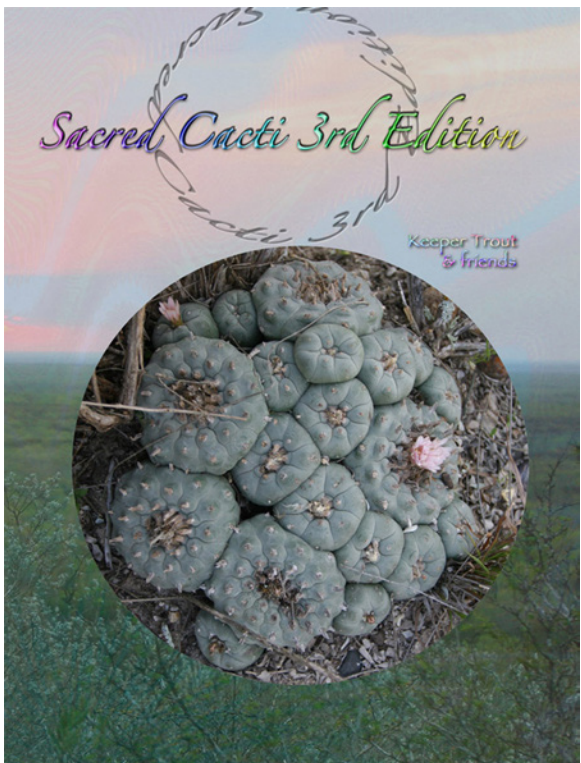
If you found this of value you may also enjoy
the opening comments from *Sacred Cacti*

http://www.largelyaccurateinformationmedia.com/LAIM/SC3/SC3_A.pdf

Notocactus roseolutea



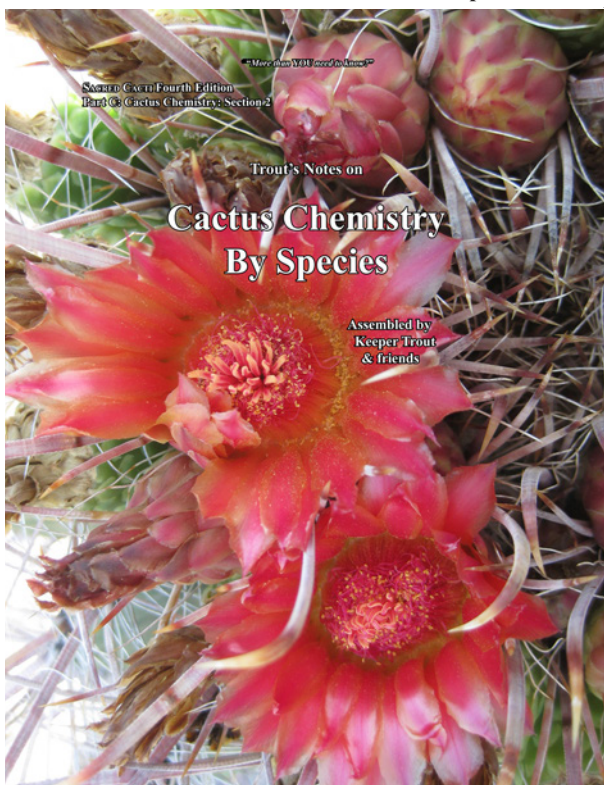
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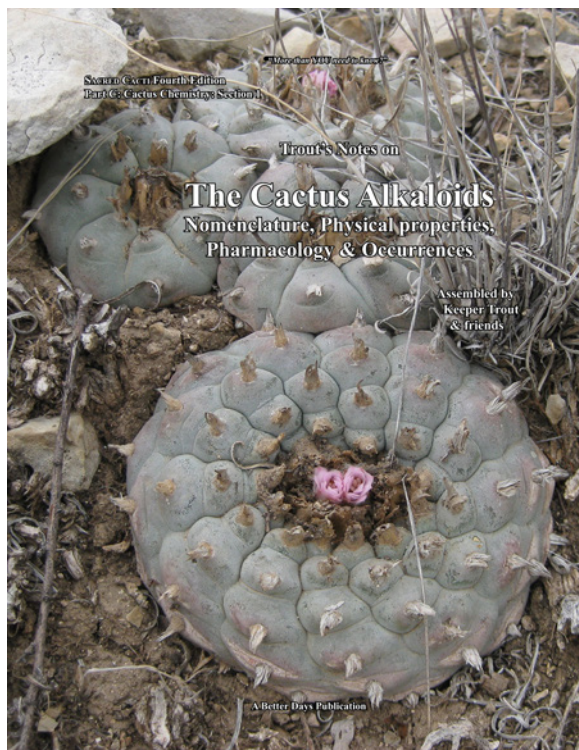
Watch for the return of *Sacred Cacti* someday.
<http://www.troutnotes.com>
It will be a 4th edition before it reaches print.



San Pedro
the book is distributed by Moksha <http://www.entheobiblica.com/>
PDF: <http://www.largelyaccurateinformationmedia.com/LAIM/SP.html>



Cactus Chemistry By Species
<http://www.largelyaccurateinformationmedia.com/LAIM/C10.html>
or for the previous version (*Sacred Cacti* 3rd edition)
<http://www.largelyaccurateinformationmedia.com/LAIM/C10o.html>



The Cactus Alkaloids
<http://www.largelyaccurateinformationmedia.com/LAIM/C13.html>

Want more Trout?

Cactus Cultivation (this work)
<http://www.largelyaccurateinformationmedia.com/LAIM/C2.html>

Trout's Notes #D-2
Second 2002 printing with minor revisions
Adapted for webviewing March 2004

Trout's Notes
on
the Genus *Desmodium*
(Chemistry, Ethnomedicine, Pharmacology, Synonyms and Miscellany)

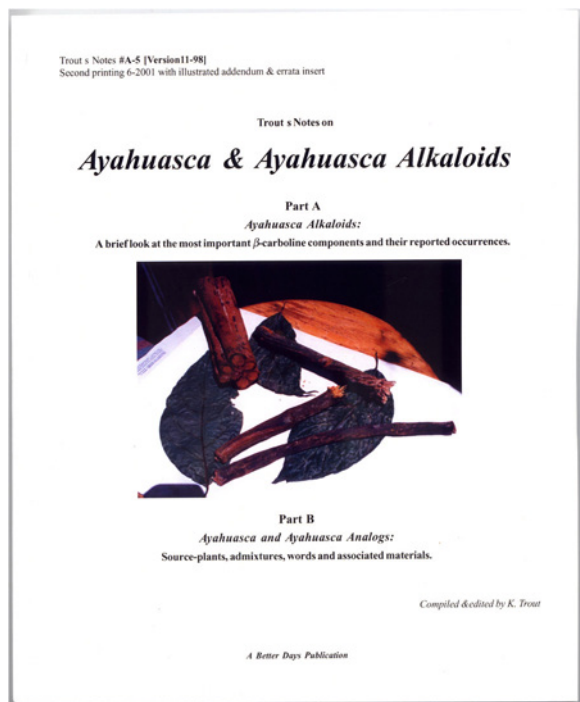
Compiled and edited by K. Trout
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A Better Days Publication

1

The Genus *Desmodium*
http://www.troutnotes.com/sc/D2_2004_Trout.pdf



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Chapter 5 (with corrections & edits: rev. 17 April 2004)

This prepublication preview was excerpted from
Sacred Cacti Third Edition (2005?)
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Sceletium sp. nova



Delosperma ecklonis
Delosperma britteniae?
Coegakop



Delosperma sp.
Hanburg 24095

**Trout's Notes on
Some Other Succulents**



featuring: Notes on the AIZOACEAE;
with particular reference to the genus *Delosperma*

by Trout & friends

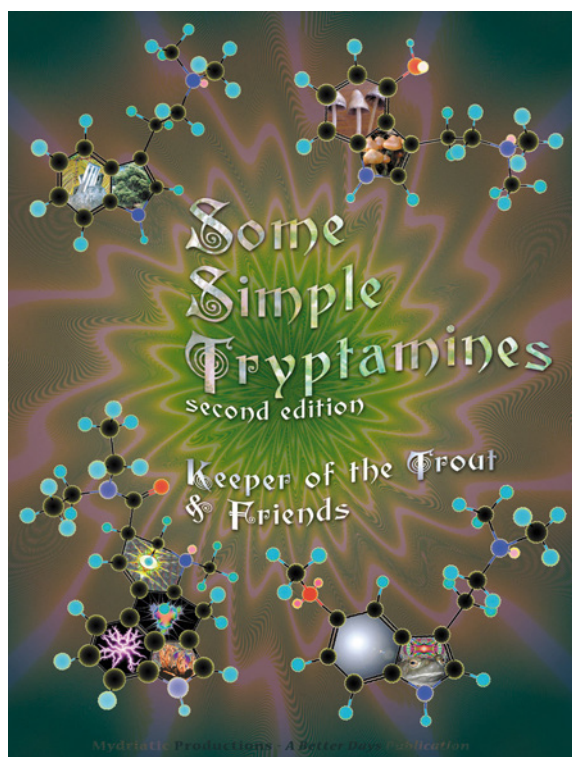


Monadenium lugardae



Delosperma britteniae? Coegakop

Some Other Succulents
http://trout.yage.net/sc/SoS_2004_Trout.pdf



Some Simple Tryptamines
Hardcopy book & online PDF
<http://www.largelyaccurateinformationmedia.com/LAIM/SP.html>

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A very nice private collection





Eriocyce sandillon (above)

Echinocereus salm-dyckianus (below)



Trichocereus thelegonus



Cristate *Lophophora williamsii echinata*



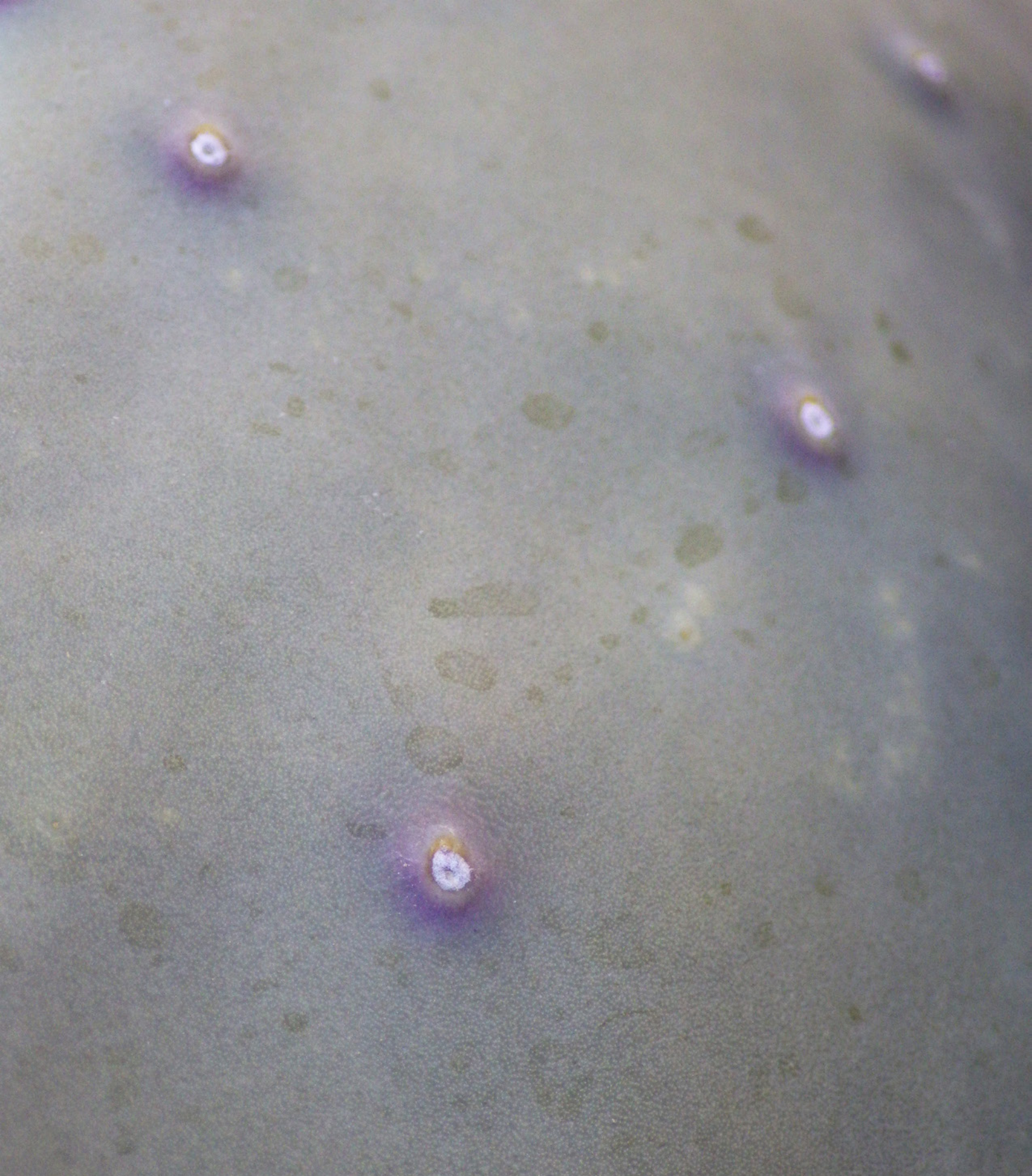
Mammillaria muehlenpfordtii





Opuntia tunicata

19261
MATHED CHULLA
TUNICATA



Opuntia ellisiana

short-spined
Trichocereus
bridgesii

*Trichocereus
pachanoi*





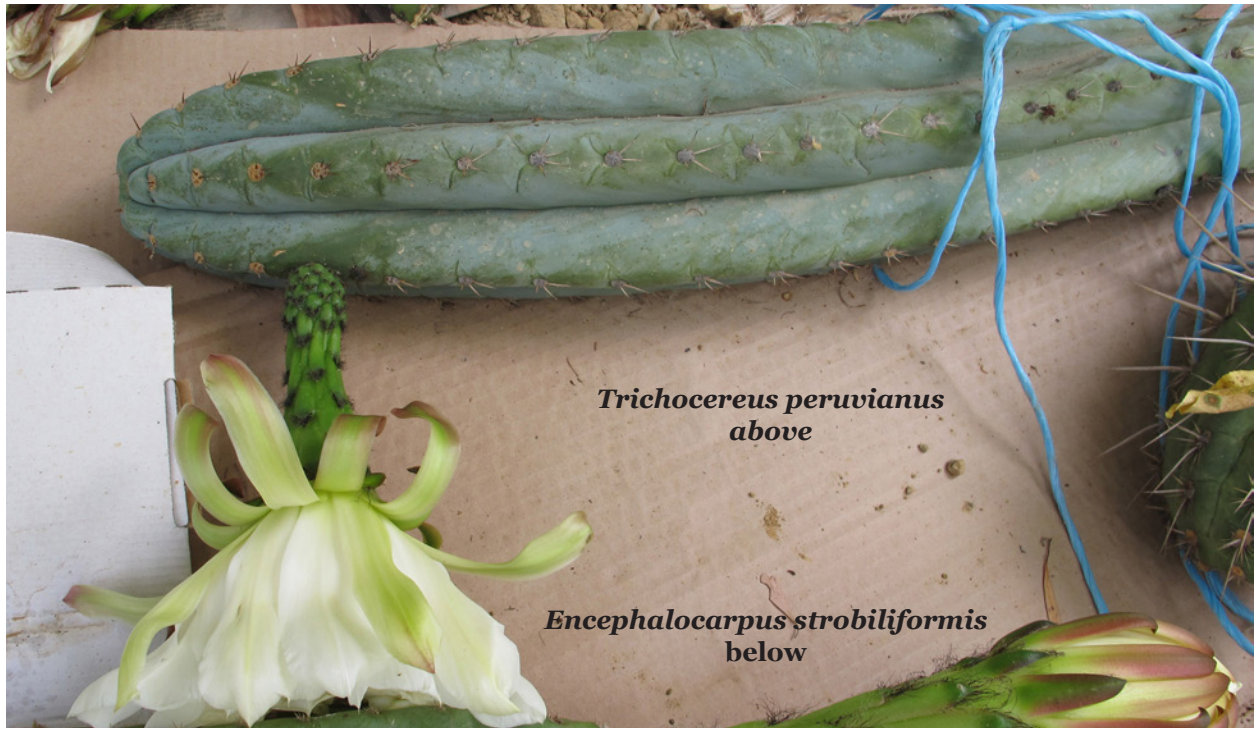
Short-spined *Trichocereus peruvianus* collected from the wild above Matucana; now in California. Seller in Peru (HP) claimed that this strain was employed by shamans as one of the “five San Pedros”.

Trichocereus scopulicola

*Trichocereus
scopulicola*



Trichocereus
scopulicola



Trichocereus peruvianus
above

Encephalocarpus strobiliformis
below

