

## **Succulents in Miami-Dade: Planting a Dry Rock Garden**

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### **Introduction**

The aim of this publication is twofold: to promote the use of succulent and semi-succulent plants in Miami-Dade landscapes, and the construction of a modified rock garden (dry rock garden) as a means of achieving this goal.

Plants that have evolved tactics for surviving in areas of low rainfall are collectively known as xerophytes. Succulents are probably the best known of such plants, all of them having in common tissues adapted to storing/conserving water (swollen stems, thickened roots, or fleshy and waxy/hairy leaves). Many succulent plants have evolved metabolic pathways that serve to reduce water loss. Whereas most plants release carbon dioxide (CO<sub>2</sub>) at night (produced as an end product of respiration), many succulents chemically 'fix' CO<sub>2</sub> in the form of malic acid. During daylight this fixed CO<sub>2</sub> is used to form carbohydrates through photosynthesis. This reduces the need for external (free) CO<sub>2</sub>, enabling the plant to close specialized pores (stomata) that control gas exchange. With the stomata closed water loss due to transpiration is greatly reduced. Crassulacean acid metabolism (CAM), as this metabolic sequence is known, is not as productive as normal plant metabolism and is one reason many succulents are slow growing.

Apart from cacti there are thirty to forty other plant families that contain succulents, with those of most horticultural interest being found in the Agavaceae, Asphodelaceae (=Aloaceae), Apocynaceae (now including asclepids), Aizoaceae, Crassulaceae, Euphorbiaceae and scattered in other families such as the Passifloraceae, Pedaliaceae, Bromeliaceae and Liliaceae. There are also non-succulent, woody plants (trees and shrubs), as well as palms and cycads, which have adapted to areas where there is little annual rainfall. These are not the focus of this publication.

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There are many advantages to growing the plants discussed in this publication. Many of the slower growing items offer bold, fixed forms that ideally accentuate contemporary building design. Other succulents can be chosen to provide seasonally showy flowers or, where more permanent but less vibrant color is required, attractively variegated foliage. As far as maintenance is concerned, all of these plants usually adapt well to infertile, rocky soils, many being able to withstand the calcareous soils present in Miami-Dade. In addition, they require little or no supplemental water, minimal amounts of fertilizer and are troubled by few serious insect pests. A dry rock garden is a good alternative to grass in open sunny areas of the yard, and represents an economical use of space without plants crowding out one another. In addition since many succulents are slow growing, routine maintenance chores such as pruning are greatly reduced and staking or trellising is seldom required. This is not a 'no-maintenance' garden. As will be described below, regular hand weeding is absolutely essential, especially during the summer rainy season.

The publication consists of two main sections. The first describes how to create conditions suitable for succulent plants to survive in a south Florida landscape. As tropical and semi-tropical plants adapted to far more arid conditions than those found locally, this is best accomplished in Miami-Dade by constructing a modified rock garden. For the purpose of the present publication, this is referred to as a dry rock garden. This is not to be confused with the term as it is applied to the contemplative (Japanese Zen) dry rock garden (Karesansui – “dry landscape” garden). Here rocks are carefully selected for their shape and precisely placed in a sea of raked sand, to express concepts of Zen Buddhism.

The final section of this publication reviews some of the plants that can be used in a dry rock garden, concentrating on succulents other than cacti. Before going into specific details, some background information is in order with reference to the terms rock garden and dry garden.

## **Rock Gardens**

Rock gardens first developed in England from early 19<sup>th</sup> Ct. stoneries, piles of rock that were placed in the garden, and left bare of plants. The rock pile was viewed as an end in itself, a landscaping attempt to construct miniature mountains. Later, efforts were made to soften the appearance of these stark, unattractive rock piles by installing low shrubs and creeping plants amenable to such a location. As the 19<sup>th</sup> Ct. drew to a close there was an increasing interest in alpine plants, and the rock installations described above were used as sites to feature alpinists in the garden landscape. The term alpine is understood today to include plants growing in mountainous areas of the world, usually adapted to exposed sites, wide temperature fluctuations and thin soils with limited available moisture. Instead of what had been random piles of stone, rock

gardens became more sophisticated. Increasing attention was paid to placing stones to replicate authentic geological formations, and simulate a range of micro-environments suited to the needs of individual plants. This is in contrast to a rockery, a term usually applied to the placement of large stones/boulders in the general landscape as decorative items, with no attempt at creating a 'natural' landscape.

Rock gardens have, of necessity, become modified to accommodate gardeners in milder climates, where strictly alpine plants are unsuited to the increased exposure to heat and humidity. Indeed, rock gardens are a highly adaptable form of gardening, ideal where space is limited, but also offering great potential as elaborate landscape features.

## **Dry Gardens**

A dry garden is a section of the landscape specifically laid out to accommodate plants that normally grow in areas of low annual rainfall. This differs from xeroscaping where no special provisions are made for plants that are adapted to low rainfall. The indigenous plants used in local (Miami-Dade) xeroscapes, experience a seasonally wet climate with more than 60" of rain annually, but can withstand periods of drought with little or no supplemental water. The plants grown in a dry garden occur naturally in areas that are more arid year round than Miami-Dade. This necessitates creating conditions that permit these plants to survive in our local landscape.

Creating a suitable niche for succulents in the Miami-Dade landscape invariably means incorporating some of the principles used in rock gardening. At its most basic level this would be the construction of a modified raised bed. For the purpose of the present publication this is referred to as a dry rock garden.

## **What to consider when landscaping with succulents**

Of paramount importance when growing succulents in the landscape is the need for soil that rapidly dries out at the surface, but retains some moisture at lower depths. Many succulent plants are prone to rot at the soil line, but there should be some moisture available at lower depths for uptake by the plant's root system. The porous limestone or sandy soils, which together are found in much of Miami-Dade, are a plus in this regard; however the flat landscape and high water table can potentially create problems. This is especially so during the heavy tropical downpours of summer when surface water frequently accumulates. In addition there are few naturally sloping sites to take advantage of, where drainage of surface water would be more rapid. Clearly sections of the yard that are known to be prone to flooding should be avoided. As will be seen below there are succulents that can succeed in a Miami-Dade landscape

without recourse to building a dry rock garden. For success however, it is essential that measures are taken to provide a fast draining site that allows prompt drying out of the soil after rainfall.

Irrespective of whether or not you construct a dry rock garden, it is important to select a part of the yard that is in full sun<sup>2</sup>. This is not only for optimum growth and flowering, but to encourage rapid evaporation of moisture from plant surfaces thereby lessening the risk of disease. In this connection, avoid areas where water can drip onto plants long after it ceases raining, such as beneath roof over-hangs or tree limbs. Choose a site well away from lawn sprinklers. Watering any of the succulents listed below will rarely be necessary, and if required is best accomplished by hand. Excellent air circulation is also important to reduce the risk of disease, especially in view of the locally high levels of humidity for much of the year.

### **Constructing a dry rock garden**

Although there is the initial investment of time and materials in constructing a dry rock garden, this is off set by the numerous advantages of growing plants adapted to this type of garden as was outlined above in the 'Introduction'.

*What to do before beginning construction* In essence, a dry rock garden is an attempt to create a mini-habitat favorable for plants that are normally found in a far more arid climate than that of Miami-Dade. Having identified sites within the yard that meet the criteria described above for landscaping with succulents, final placement of the garden will depend on other factors. Of these, the intended size of the garden is of paramount importance. Rock gardens are very adaptable as to size and degrees of elaboration. For a small yard they can be little more than a simple raised bed faced with rock or masonry, with plants growing in a modified scree mix (see below). In a larger yard the rock garden could be tiered, and include large boulders<sup>3</sup>, walkways, even an artificial stream and/or pond and waterfall. Irrespective of whether you have plenty of space, it is advisable to start with a modest installation to establish how well the plants that interest you will perform under your conditions. If you are disappointed with the results, then at least you will have limited the investment of time and money, and be able to more easily transform the garden to other uses.

Since there is little need to water a dry rock garden, try to situate it in a part of the yard with other drought tolerant plants. When planning your landscape, it is easier, and more economical to group plants having similar water requirements together. Think ahead so that future landscaping projects do not compromise

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<sup>2</sup> In those instances where some shade may be required, this can be accomplished by the strategic placement of rocks and other succulents.

<sup>3</sup> The Wentworth scale classifies rocks having dimensions in excess of 10" as boulders (cobble is greater than 2.5", while below this are various sizes of gravel and sand).

your dry rock garden. For instance avoid any part of the yard where you may be thinking of installing a large tree. Not only could this create too much shade, but surface roots are liable to grow up into the raised bed.

The remaining factors that enter into where to situate a dry rock garden are less horticultural, and based more on aesthetic considerations. However elaborate the design of the garden it should blend in with the surrounding landscape. Remember that the essence of a dry rock garden is a degree of informality, a hint at least of a natural landscape. For this reason situating it in the middle of an expanse of lush green turf would look out of place. Avoid areas of the yard where other elements in the landscape could dilute the impact of your rock garden, for instance plants with showy year round flowers (e.g., hibiscus or ixora), boldly colored/variegated leaves (copperleaf, crotons) or coarse texture (Chenille plant or Brazilian cloak). An area adjacent to an open patio, driveway, or in a sunny corner of the yard (preferably southwest) will permit this garden feature to blend in with the rest of the landscape. As background plants use those with wispy/airy foliage, especially in the immediate background, to provide a fairly neutral gray/green backdrop. In the immediate background consider using native, ornamental grasses (e.g., *Muhlenbergia capallaris* var. *filipes*<sup>4</sup>), while further back a few clumps of weeping bamboo (*Otatea acuminata aztecorum*<sup>5</sup>), sweet acacias (*Acacia farnesiana*) or other small trees with diminutive flowers and lacy foliage (e.g., *Lysiloma sabicu*). Small to medium sized palms (e.g., *Thrinax* spp., thatch palms) can also function as excellent perimeter plants. Note that all of these plants will survive without irrigation (see below).

Even for the simplest installation it is advisable to draw up plans before commencing construction. Include the shape and dimensions of the garden, any features you wish to incorporate, as well as the placement of plants and rocks. Avoid the straight-sided, rectangular appearance of raised beds used for bedding plants and vegetable gardens. A far less formal appearance is preferable featuring irregular curved sides (e.g., reniform). Avoid having turf grass growing right up to the edge of the raised bed. Make allowance in your plan for an 18" perimeter transition area of gravel, which could in part double as a footpath.

Decide ahead of time which succulents you will be planting. You may have a particular interest in a single group such as aloes, agaves or sun-loving bromeliads. Conversely you may prefer a variety of different specimens as long as they exhibit some common characteristic, such as showy flowers or developing a swollen caudex ("fat plants"). You could also use boulders to section off areas of the garden, each featuring a group of related plants. Having an idea of what you wish to plant will determine the space you need, and the placement of rock outcrops. Make allowances for increases in girth (some agaves will grow to a width of more than 12'), succulents that spread by

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<sup>4</sup> Clumps of hairy muhly grass will grow to 1-3', depending on available moisture

<sup>5</sup> Allow room for clumps of Mexican weeping bamboo to spread (4-5'), with a maximum height of 10-20'

producing offsets (e.g., aloes and agaves), become tree-like (many pachypodiums) and cactus-like (euphorbias) or benefit from light shade (stapelias). Above all, when planning your garden, resist the temptation to crowd plants together. Ensuring good air circulation is an essential part of reducing the risk of disease.

*Materials required for building a dry rock garden* The raised base of the garden can be made out of rubble removed during construction projects, such as digging out a pool, or any pieces of broken/scrap masonry. If you are incorporating large boulders in your garden design, it costs much less to use locally available materials (Miami limestone in the case of south Florida). For any smaller rock outcrops, feather rock (a type of volcanic glass) although expensive, is very light, easily shaped and a neutral light gray color. Avoid brightly colored rocks, such as red lava, which will detract from the impact of the plants, and avoid mixing rocks of different types, especially if you are aiming for a naturalistic appearance. To fill in any voids prepare a mixture of pea gravel, crushed coral rock, and fine poultry grit (granite, not crushed shells) or coarse (mason's) sand (1 mm grain), not fine play sand, which can impede drainage. If you favor a more formal appearance you will need either natural stone (Miami limestone) or, as a less expensive alternative, pre-cast masonry to construct a low retaining wall.

For the modified scree mix (see below) that will cover the top of the raised bed purchase sufficient coarse poultry grit, ½" gravel, coarse (builder's) sand, Canadian peat (or coir) and a potting soil. Sphagnum peat moss (those that include a wetting agent are easiest to use) is preferable to coir since it retains less moisture, and the potting soil should be one containing composted pine bark<sup>6</sup>. Only use composted yard waste (no weeds or diseased plant parts) if the compost pile reached working temperature (160°F), and the plant material has completely broken down. The product should be black and crumbly. As inorganic mulch you will need a mix of ½-¾" river rock (Chattahoochee).

*Building the raised bed* Following the design you have sketched, use spray paint to outline the area in the yard where the dry rock garden is to be constructed. Within this area remove turf grass, weeds, plant debris etc. to leave bare ground. If the soil is heavy and drains poorly (e.g., marl), dig down 6-12" and fill with a mix of small rocks (e.g., drainfield rock), pea gravel and coarse sand. Elsewhere in Miami-Dade the rocky soils and underlying porous bedrock provide sufficiently good drainage to permit constructing the raised bed directly on the cleared bare ground.

The simplest design is basically a raised bed, a flat-topped mound (berm) of rubble/scrap masonry. Build up the mound to a height of 18-24", high enough to keep feeder roots out of any saturated soil. Use larger rocks to build up the

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<sup>6</sup> The ingredients used in mixing the potting soil will be listed on the bag.

base, fitting smaller stones in between (see Fig 1, a sketch representing a cross section of the raised bed indicating placement of materials used). Fill in the remaining voids with a mix of pea gravel, poultry grit, crushed coral rock and coarse sand. Continue building up the bed to the desired height then soak it thoroughly with water and leave to settle for a few days. For a more adventurous design, you can build the bed up in tiers, with a series of low retaining walls (dry walls, made from available rocks and stones). Use larger boulders to simulate outcrops, partially burying them (at least 25%) to make for a more natural appearance and for added stability. Note tiered construction in Fig. 1 with placement of larger boulders to provide some shade. If you wish to simulate a natural mountain scree formation<sup>7</sup>, build up a gently sloping fan-shaped bed, flanking it on either side with a selection of larger rocks.

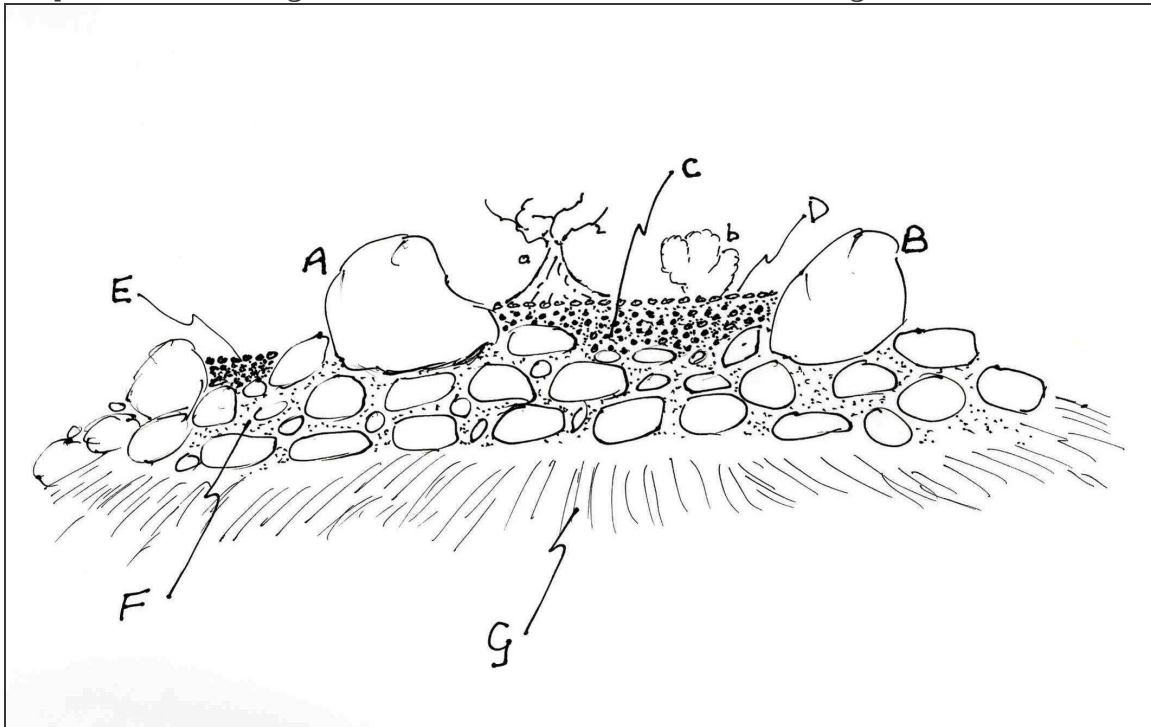


Figure 1 Construction of dry rock garden showing materials used: (A, B) large boulders; (C) scree mix (see text) showing placement of specimen succulents a and b; (D) inorganic mulch, ¼ to ½” aggregate; (E) lower terrace area with some shade from boulder A; (F) base composed of assorted rubble/rocks with gravel/sharp sand to fill voids.

Somewhat more formal, but still most attractive is a raised bed faced with a dry stone retaining wall. This takes some skill in stacking the rocks, and must not be more than 3’ in height. You should set the height of the wall using a string level to adjust a twine guide line. Not as attractive, but easier to assemble and costing much less, a range of pre-cast masonry is available in simulated natural stone finishes. With larger installations, more than 4’ in width, a few

<sup>7</sup> A scree is an accumulation of loose rocks and stones at the base of a steep slope, often in a dry gully between two mountains.

strategically placed flagstones will permit access for weeding, and other maintenance chores, avoiding the risk of compacting soil or treading on plants.

The top of the bed should be covered with about 3-4" of modified scree mix containing 6 parts mixed gravel/poultry grit; 2 parts coarse sand; 1 part fresh potting soil; 1 part Canadian peat. Scree mixes are used extensively in rock gardens and consist mostly of fine to medium size aggregate (coarse sand, grit and various sizes of gravel) plus varying amounts of organic matter. There are many modifications to this mix to suit particular situations. In an area of high rainfall such as south Florida, it is best to limit the amount of organic matter incorporated. The mix can also be adjusted to meet the needs of the plants grown. A less coarse mix for plants with fine roots (e.g. crassulas) and coarser for adeniums, aloes and stapelias.

The modified scree mix should be covered with 1" of inorganic mulch (1/2 - 3/4" gravel). Not only will this help to suppress weeds, it also prevents soil from being splashed onto the stem or foliage when it rains thereby reducing the risk of disease. Do not use organic mulches such as pine bark, since the soil surface can remain excessively moist.

## Installation and Care of Plants

Before choosing and installing any plant, be aware that many of the succulents used in a dry rock garden possess very sharp spines/prickles<sup>8</sup> and/or poisonous sap. Use due caution when situating them in the garden, particularly large specimens (many agaves and large succulent euphorbias), keeping them away from the edge of garden paths and sidewalks. Exercise caution when working around these plants - wear thick gardening gloves and a long sleeved shirt/blouse and eye protection, particularly near large succulent euphorbias. Where pruning is necessary, specially designed long handle pruning saws (cactus saws) are available that reduce the risk of injury from armed succulents. Never use a chain saw – they can spew irritant/poisonous sap over the operator.

*Installation:* There are many reasons why it is best to install small plants. In general they become established much more readily, are less liable to root damage when transplanting, and adapt more readily to outdoor sun exposure. Whatever plant is chosen, it must have a rootball that remains intact on removal from its container. In this respect be particularly careful in transplanting succulents you have grown from cuttings. Before taking a plant from its

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<sup>8</sup> Two structures common to many succulents, including agaves, are spines and prickles. A spine differs from a prickle in being more firmly attached to the plant. It arises from beneath the plant epidermis (surface cells), corresponding to a modified stem or stipule (bract like appendages at the base of a leaf stalk) with a sharply pointed tip. A prickle is a direct outgrowth derived from epidermal cells, and is therefore much more weakly attached. Thorns are stiff, woody, modified stems and despite the common names applied to several of the plants below are rarely found in any of the succulent plants described below.



container, first carefully rake back the gravel mulch and then remove the underlying scree mix to form a hole large enough to accommodate the plant. Add any amendments (e.g., additional organic matter) to the scree mix you removed and set this aside. Position the plant so that the top of the root ball is just above the rim of the planting hole. Carefully backfill with the set aside scree mix, then push the mulch back under any low leaves/stems so that the root ball is covered.

If you purchase succulents from out of state they may well arrive as bare root plants, especially larger specimens. Any fine feeder roots will most likely have dried out, so these will need to be replaced before the plant can become established. On receipt of such plants they should be planted in a potting mixture containing mostly inorganic material with less than 10% Canadian peat (some growers use pure pumice) that is barely moist. Do not water until there are signs of renewed growth (new leaves) to reduce the risk of rot. A large bare root succulent will contain sufficient water to meet the plants needs for several weeks. The plant will need to remain in a container until it has developed a full root system before attempting to place it in the rock garden. This could be up to a year for some slow growing succulents.

It is not a good idea to move succulents already established in the landscape. This is particularly so for caudiciforms where removal is impossible without damage to the roots and much of the caudex. Container plants that are being moved to a landscape site in full sun should be adapted in stages to their new exposure before planting in the garden. Provide some protection for the caudex of plants that were previously not exposed to intense sunlight.

*Water* For most of the year rainfall in Miami-Dade will be more than adequate for a dry rock garden, especially from late spring through early fall. During periods of cool dry weather it is best to completely withhold water. Where watering is necessary (indicated below), do so by hand around the base of the succulent, without wetting the plant surface. You can use a wand extension fitted with a water breaker to gently apply water without splashing the lower leaves. Apply sufficient water to soak into the raised bed – if this is done early in the day the soil around the base of the plant will dry out with the heat of the sun.

*Light* In most instances full sun is preferred for succulents grown in Miami-Dade. This helps hasten evaporation of water from the soil surface and reduce the risk of disease. For some succulents light afternoon shade can be tolerated and is even recommended (e.g., some trailing/climbing asclepids, stapeliads, aloes, kalanchoes and adenias). Many previously published recommendations are for succulents grown in containers, where soil moisture is lost more rapidly, or for arid parts of the country that experience prolonged spells of hot summer sun. In Miami-Dade, with 40 -50” of summer rain it is more important to

position succulents so as to promote rapid drying of the surface 1-2" of soil rather than limiting sun exposure.

*Maintenance* The most important maintenance chore is weeding, and this is not just a matter of appearance. Weeds growing around the base of succulents can cause a build up of moisture at the soil line, leading to basal rot of the stem. During summer you will need to check your dry rock garden on a weekly basis, and hand pull all weeds. Grab the weed just below the soil line and gradually pull it out of the ground, trying to remove as much of the root system as possible. Common weeds to expect include various spurges, green shrimp plant (*Blechum pyramidatum*), long stemmed phyllanthus, crab grass, wild Bermuda grass and nutgrass (a sedge). In areas with some shade, (lee of a boulder, under a large plant) sufficient moisture will be present during the summer for weeds such as wood sorrel and dayflower to proliferate.

Insufficient information is available regarding the use of pre-emergent herbicides in the vicinity of the succulents discussed below. Spray application of post emergent herbicides should be avoided. Products containing glyphosate can be carefully applied onto the tops of weeds (leaves) using a long-handled sponge applicator (as used for washing dishes). There is at least one commercially available sponge applicator for spot application of herbicide to weeds growing in flower beds.

In general there should be no need to prune the succulents in your dry rock garden except to remove diseased/dead plant parts. Any pruning that is required is best done during dry warm periods (i.e. late winter early spring) to reduce the risk of rotting. When temperatures fall below 40°F inspect succulents that are prone to cold damage such as adeniums, adenias, and uncarinas. Damaged stems will be flaccid and may eventually shrivel and rot – these should be promptly removed.

*Propagation* Only some general guidelines can be given here. Most succulents are quite easy to propagate from stem cuttings if they are first allowed to dry out for 5-7 days. In Miami-Dade cuttings are best taken from late fall to early spring, when there is less risk of them rotting. If there are episodes of cool wet weather within that period, any cuttings that have not rooted should be taken indoors. Do not insert more than ½" of the dried cutting into barely moist growing medium – support the rest on the rim of the pot or between two thin strips of dowel rod secured horizontally across the top of the container. Provide moisture by occasional gentle misting of the cuttings to prevent them from drying out. Avoid applying water directly to the soil until the cutting has successfully rooted. Provide bright light to partial sun, allowing more exposure to full sun as the cutting takes root. Leaf cuttings taken in spring can also be used for some plants, such as crassulas and kalanchoes. Agaves, some aloes and dyckias produce offsets which can be separated from the mother plant. Seed is usually not as readily available, but is preferred for most caudiciforms,

since plants grown from cuttings usually fail to develop the greatly swollen stems that characterize this group of plants.

### **A Selection of Plants for the Dry Rock Garden**

There are a number of succulents, such as desert rose, pachypodiums, agaves, aloes and many euphorbias that can be expected to do well in a Miami-Dade dry rock garden. For others it will be a case of learning by trial and error, since there is a limited amount of experience growing succulents as outdoors landscape plants in south Florida. Those that are relatively untried are so indicated. Unless a plant is rare or expensive, it is worth trying in your dry rock garden. Many succulents are easy to propagate from cuttings, so you could grow additional plants and assess their response to variables such as the ratio of scree mix components and location within the rock garden.

Bear in mind that your main enemy is going to be susceptibility to disease, especially leaf spots and stem and root rots. In this connection, one factor to consider when contemplating growing something new is plant dormancy. Succulents from areas of winter rainfall (e.g., Mediterranean type climates) are adapted to dry summers, a time when they usually become semi dormant. Other succulents that may not adapt to local conditions are those found in high cool deserts. In either case these plants are at risk of rot and foliage disease in south Florida's hot, wet summers. The plants selected are arranged below in alphabetical order according to genera.

***Adenia* spp. (Passifloraceae)** These sprawling, caudiciform plants are found mostly in southern and eastern Africa. They are grown for the striking, greatly swollen, globose to flask shaped base (some with a diameter of more than 6' in the wild), from which emerge numerous long, thin, often spiny stems. Foliage is usually sparse, leaf form simple to palmately lobed (cf. passion vines). The fleeting, small, greenish yellow flowers are sweetly fragrant. As with many caudiciform plants, it is necessary to grow from seed rather than cuttings in order to ensure a fully expanded caudex. This process can take many years, though adenias are faster growing than many other pachycaulous plants, particularly if given some fertilizer during the summer growing season. Usually grown in large containers, they are regarded as being one of the easier caudiciform succulents to grow. However little information is available on their use in dry gardens.

*Adenia* spp. should be grown with stems exposed to, and the caudex protected from, full sun. A neighboring plant or carefully placed rocks can be used to shade the caudex from strong afternoon sun. In the authors experience exposure to full sun in Miami-Dade has so far not resulted in sun scorch. Some support should be provided for any trailing stems. Since adenias prefer somewhat acidic soils, supplement the scree mix with additional Canadian

sphagnum peat when planting and omit any ground limestone rock. *Adenias* will respond to an application of slow release fertilizer at the beginning of summer. They tend to become dormant during the winter at which time water only when temperatures are above 75°F and the plant retains foliage.

*Adenia glauca* is one of the more readily available species, amenable to growing outdoors, and relatively fast growing. The leaves are attractively lobed, the flowers cream colored and rather insignificant. *Adenia globosa* is claimed to be more suited to humidity than other species in cultivation. It develops a large, dull green somewhat warty caudex, from which arise many thin thorny stems, which should be thinned to 8-10 shoots, with small leaves.

Caution: *Adenia* plant parts and sap are extremely poisonous, ricin-like toxins having been isolated from the roots.

*Adenium obesum* (Apocynaceae) Commonly known as the desert rose, this is one of the most popular of caudiciform succulents, grown for both the swollen stems and extremely showy flowers. There is controversy as to whether this taxon, now a part of the Apocynaceae, should be considered a single species, with several subspecies, or divided into several wholly distinct species. For the purpose of this publication the former division is adopted. In a dry rock garden allow for a final width of 3-4' and height of no more than 4-5', choosing a position in full sun. When planting handle with care, especially large specimens, since desert rose roots break easily. Add about two cupfuls of Canadian peat per cubic foot of the modified scree mix for use as backfill. Growth is quite rapid for the first two years and the desert rose will respond well to applications of fertilizer during the warmer months of the year, and supplemental water during hot dry weather. Curtail fertilizer use and severely limit watering during the cool season, withholding water altogether as temperatures fall below 75°F. For mature specimens provide two applications of slow release fertilizer in late spring and again in late summer. Watch for scale insects, especially during late fall into winter.

*Adenium obesum* subsp. *obesum* 'Multiflorum' with seed follicles

Most commonly grown is *A. obesum* subsp. *obesum*, of variable appearance though it can be distinguished from subsp. *obesum* 'Multiflorum' by the deeper red petal margins contrasting with the white throat.



The latter *Adenium* also exhibits greater dormancy during winter dropping all leaves during the late fall/early winter. *Adenium obesum* subsp. *bohemian* has much larger leathery leaves, subsp. *oleofolium* long slender leaves, subsp. *swazicum* develops a low spreading growth habit and flowers when still in leaf (pink to red flowers) and subsp. *somalense* develops a crown of thin, much branched stems. For a particularly impressive, squat caudex, choose subsp. *arabicum* 'Shada'. Unlike the previous species this contains a clear yellowish sap rather than the milky sap usually found in desert rose. In the author's experience this selection, compared to other adeniums, is far more liable to infestation with spider mites. Desert rose sap is poisonous – take care when pruning or taking cuttings.



*Adenium obesum* subsp. *obesum* 'Multiflorum' - seed grown specimen in Miami-Dade landscape showing developing caudex.

Many *Adenium* cultivars having very showy flowers are available including several hybrids recently developed in Thailand and Taiwan. These offer flowers in magenta, purples, and scarlet as well as some with variegated foliage. Current interest focuses on the first successful attempt to breed a desert rose with double flowers. A full description of desert rose and its' use in the south Florida landscape is available on request<sup>9</sup>.

***Aeonium* spp.** (Crassulaceae). This group of plants come mainly from the Canary Islands and extreme NW Africa. They produce rosettes of thick, generally obovate bright green leaves that can be variegated or tinged red to purple. On some plants the rosette of leaves forms close to the ground, whilst others develop long stems. After an individual rosette of leaves produces an inflorescence, it will die and is best removed. Most aeoniums are clump forming and readily produce offsets, which then develop a new rosette of

<sup>9</sup> Download the publication 'Desert Rose, *Adenium obesum*' from <http://edis.ifas.ufl.edu/publications.htm>.

leaves. They should be planted during early fall, in a bed of the modified scree mix. Although grown in containers by succulent enthusiasts, there is not much information on the use of aeoniums in south Florida landscapes. Their summer dormancy could render them vulnerable to disease in south Florida. Those such as *Aeonium* 'Bronze Medal', that are minimally dormant are most likely to survive. Plants sold as *Aeonium arboreum*<sup>10</sup> should succeed in Miami-Dade, and can be placed in full sun. Many other species require some shade from hot summer weather, including the spectacular *Aeonium* 'Swartzkopf'<sup>11</sup>, with its' garnet colored leaves.

**Agave (Agavaceae)** One of the easiest of succulents to grow in south Florida, agaves are a good choice for those just starting a dry rock garden. A large number of species and cultivars available for cultivation, some of the most popular (e.g., *Agave americana*) used as general landscaping items without recourse to constructing a dry rock garden. All that is required is a perfectly free draining soil and full sun. Agaves are appreciated for the rosette of large, stiff, more or less lance shaped leaves.



*Agave americana* 'Marginata'

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<sup>10</sup> The plants sold as *A. arboreum* are believed to be mixed hybrids, the true species is rare both in cultivation and in the wild, and is generally accepted to be synonymous with *Aeonium korneliuslemsii*

<sup>11</sup> *A. 'Swartzkopf'*, which is not a scientifically accepted name, is sometimes listed as a *A. arboreum* 'Swartzkopf' or *A.atropurpureum* 'Schwartkopf', but the currently accepted name is *A. manriqueorum* cv. 'Swartzkopf'.

The foliage, ranging from bright green to an attractive grey to blue green, is sometimes variegated and often glaucous. In some agaves the foliage emerges attractively patterned with the imprint of neighboring bud leaves. The leaves arise from a short, stout, typically non-branching stem. They are frequently tipped with a sharp spine with the margins armed with numerous pointed teeth.

In addition to the armed leaves, care should be exercised to avoid skin or eye contact with the sap, which is highly irritant/allergenic (contains saponins and calcium oxalate crystals). The popular name century plant refers to the lengthy time before the plants flower. In actuality the time that elapses is much shorter than a century, usually never more than 30 - 40 years, and considerably less for the smaller species. The inflorescence is most unusual, consisting of a prominent, bracted scape (stem) up to 25' for larger species, bearing a dense panicle of yellowish flowers. Flowers are pollinated by bats, humming birds and moths, and set copious amounts of seed. While most agaves are monocarpic (the plant dies after flowering), numerous offsets are produced which can be removed as a source of new specimens. Some species produce bulbils (juvenile plants) at the tips of the inflorescence, and these readily root once in contact with soil.

Plant in full sun using the modified scree mix, allowing plenty of room for the larger agaves (mature specimens can grow to a width of 12' or more), including space to accommodate any offsets. Avoid situating large specimens next to paths and driveways. As a further precaution the terminal leaf spine may be removed, though this can detract from the overall appearance of some species. Once established use a slow release fertilizer in late spring, and remove any dead leaves, using a cactus saw for larger specimens.



*Agave victoriae-reginae*. Note patterning on leaves due to bud imprint

Most familiar is the century plant, *Agave americana*, usually grown with other full sun landscape items where it succeeds without the need for a raised bed, providing the soil is perfectly free draining. This is a large slow growing plant, eventually attaining a width of 12', with gray/green leaves. Several cultivars have strikingly variegated foliage, though variability in patterning makes identification difficult: *A. americana* 'Medio-picta', has a broad yellow stripe down the middle of the leaf ('Media-

**picta alba**' has a white stripe), **'Variegata'** has thin, yellow, marginal stripes and **'Marginata Aurea Monstrosa'** is a dwarf form that grows to a maximum width of 3'. This latter cultivar has wavy margined, yellow, variegated leaves and reliably suckers. It is a better choice for the small garden, the other *A. Americana* cultivars inevitably becoming too large and dominant.

The swan neck or foxtail agave, *A. attenuata*, is one of only a few spineless agaves, a good choice where there are concerns about injury from sharp spines. Compact, growing to a width of about 3', it develops a trunk like stem to about 4' as it ages. The common name refers to the arching flower stem which consists of a spike of closely packed small flowers – the masses of elongated flower filaments (part of the stamen) give the inflorescence a fuzzy, furry appearance. The spineless leaves are a pale grey/green, less rigid compared to the above agaves. The cv. **'Nova'** (now re-named **'Boutin Blue'**) has broader, bluish green leaves and an erect flower spike. *Agave attenuata* can survive some light shade (e.g., sweet acacia or carib wood), and should be watered occasionally during dry, hot (above 90°F) weather. Another, less common, somewhat larger spineless agave, *A. bracteosa* is also unusual in being polycarpic (repeat blooming). It has thin, pale green leaves, suckers freely and eventually produces a striking cream colored flower spike. Both of these spineless agaves will respond favorably if the scree mix is enriched with added organic matter.

*Agave victoriae-reginae* is a slow growing, very compact agave possessing boldly patterned, dark green, toothless leaves having a thin but conspicuous white margin, and tipped with a black spine. The cultivar **'Compacta'** is smaller, resembling an overgrown globe artichoke, developing into a 1' wide, tight ball of overlapping leaves. Another compact growing agave, *A. parrayi* var. *truncata* is larger, to 3' wide, but also resembles an overgrown artichoke. The leaves are an attractive bluish grey, broadly ovate to linear with truncated tips

bearing a prominent black spine. Offsets are usually reliably produced. The var. *huachuensis* is similar, though the leaves are a re larger with more acute tips and it freely suckers, making it useful as a ground cover.

Where a more open grass like agave is preferred, *A. stricta* produces dense clumps (caespitose) of long, pencil thin, needle sharp leaves. From a distance it resembles a light green sea urchin. This



*Agave stricta*

agave readily produces offsets, and eventually develops a short, stout, branched trunk (to about 4'). After about 15 years a spike comprised of many purplish-red flowers forms. The thin needle pointed leaves can inflict serious injuries, so be careful where you position this plant. In contrast, *A. colorata* is virtually stem less, developing a 3' rosette of broad, cupped, bluish green leaves with prominent marginal spines. This agave is usually solitary producing few offsets.

Apart from *A. americana*, there are other large agaves. *A. franzosinii* is especially striking, growing more than 13' wide and 8' in height, with large, glaucous (powdery), bluish grey leaves that are attractively reflexed. Almost as large is *A. salmiana* var. *ferox*, with pleasingly curved, bluish green leaves having small marginal teeth and a 3-4" terminal spine. Becoming 9 – 12' wide and 4' high, this forms an imposing specimen plant for a large garden. The plant readily produces offsets that should be removed to provide space for the mother plant to develop. The 25' branched inflorescence is very impressive, consisting of a stout scape bearing a broad panicle of yellow flowers.





*Agave schidigera* showing filaments

*Agave schidigera* is small (2-3'), with leaves having a sharp terminal spine, but devoid of marginal teeth. Instead the leaf margin produces numerous, long, thread like filaments. The cultivar 'Durango' has a more symmetrical form, and is used as a bedding plant. This agave does not produce offsets, and after 10-12 years bears a 10 -12' scape with a spike of purple flowers. *Agave filifera* is similar, with thicker filaments, but is clump forming (produces offsets).

Several south Florida growers produce agaves, more so than most other succulents, while a huge selection is available from mail order nurseries.

**Alluaudia (Portulacaceae)** Until recently the alluaudias were regarded as members of the Didieraceae<sup>12</sup>, a small family of unusual, shrubby to tree-like plants, most closely related to cacti. They are important constituents of the 'dry spiny forest' found in SW Madagascar, where they can grow into substantial trees. However in the landscape, or in containers, alluaudias can be maintained at a much smaller size. They are characterized by long, slender stems, with 1" thorns, below which are pairs of tiny, somewhat fleshy, rounded, sessile leaves, oriented horizontally on new growth, vertically on re-growth. During extended dry periods leaves are lost. Male and female flowers, which are borne on separate plants, are small, yellowish, in an umbel-like inflorescence, and seen only on mature plants. Since seed production requires male and female plants, propagation is usually by means of stem cuttings which root readily.

Alluaudias should be situated in full sun. For a dry rock garden they can be planted in modified scree mix, with occasional light watering until established. South Florida's summer rainfall will be more than sufficient, while during winter, where temperatures remain above 70°F water every 3 – 4 weeks in the absence of rain. During cooler weather withhold water. In their native environment alluaudias will grow into small trees, however for use in a dry rock garden, it is preferable to commence pruning early to encourage a more bushy

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<sup>12</sup> Recent taxonomic revisions now place members of the Didieraceae in the Portulacaceae

compact, habit. As the young plant matures it develops more appeal the thin thorny base of the stem slowly enlarging and becoming more caudiciform.

The most readily available species, *A. procera*, is initially low growing with many long, slender, twisted stems. assuming a more erect growth habit as it matures. *Alluaudia montagnacii* exhibits more columnar growth, with the tiny leaves inaccessible behind the rows of 1" thorns present on new growth.

The octopus plant *Didierea trollii* is from a closely related genus and in its juvenile form consists of many tangled, spiny stems with numerous small, round leaves. Eventually upright stems develop, growing into a 10-20' trunk bearing many short shoots each with five thin, terminal spines surrounding five small round fleshy leaves. The twisted, basal stems eventually die leaving only the upright trunk(s) with straight, lateral branches.

**Aloe (Asphodelaceae)** Once grouped with agaves, which they superficially resemble, most taxonomists now assign aloes to a separate family, the Asphodelaceae. Like agaves, the most popular species such as *Aloe vera* (syn. *A. barbadiensis*) are often used as general landscaping plants, without recourse to building a dry garden. They do however require a sunny site with perfectly draining soil. For descriptive purposes only, aloes can be broadly grouped into a number of different types including stemless, single stemmed, branching, grass, tree and rambling. Most of those discussed below are of the stemless or single stemmed type. The impressive tree aloes come from areas of South Africa that experience a winter rain maximum, dry summers and are usually found growing on acid sands. For these reasons, they are unlikely to adapt well to Miami-Dade conditions.

As items of landscape interest, aloes offer attractive rosettes or whorls of thick, fleshy leaves (often variegated or colored) with spiny margins. Unlike agaves the marginal spines are softer, and there is no terminal leaf spine. Another feature that distinguishes aloes is their habit of flowering annually (polycarpic, compare with agaves which are almost all monocarpic), usually from winter into spring. Aloes produce spectacular inflorescences elevated well above the leaf rosettes on tall, often branched, flower stalks. The flowers are attractive to hummingbirds. Most of the commonly grown aloes readily produce offsets (*A. vera* can become invasive given the right climate). For solitary species seed or stem cuttings must be relied on for propagation. Many aloes readily hybridize (making identification difficult), often producing plants that are more vigorous than the parent, and therefore valuable as horticultural items.

In the dry rock garden, aloes can be planted from late fall through early spring in full sun (there are a few exceptions noted below) using the modified scree mix as backfill. Allow plenty of room for large specimens, which develop an extensive root system. From late spring to early fall, rainfall will be more than adequate to meet water requirements. During the remainder of the year watering should be restricted to once every 3-4 weeks and cease during the cool winter months.

The main pests are mealybugs (often indicated by the presence of ants and black sooty mold) and mites. The latter are stated to be particularly frequent on *Aloe saponaria* (soap aloe) and cause adventitious growth of stems and leaf bases. This condition is sometimes referred to as 'aloe cancer', and has been ascribed to a virus vectored by the aloe mite. Recently there has been a report of a new pest infesting Florida aloes, the aloe aphid. This pest can be superficially confused with mealybugs, and is usually found in leaf bases. In the US south west, aloe rust can be a problem especially in winter, but is rare in Florida. Aloes, more especially medium size specimens, can suffer a tip burn/die-back of the leaves if soil is allowed to dry out excessively during hot weather.

There are many species/cultivars of aloe to choose from, *Aloe arborescens* being most widely grown as an ornamental. This is a large (6-8'), branching aloe, which forms extensive clumps. Each individual plant forms a rosette of narrow, soft toothed, grayish green to dull green leaves. In early winter elongated flower stems appear bearing an orange to red conical inflorescence about 2' above the foliage. The cultivar '**Variegata**' has leaves with creamy white variegation, and '**Lutea**' a yellow inflorescence. A hybrid between *A. arborescens* var *pachythyrsa* and *A. humilis* var. *echinata* is offered as *A. x spinosissima* (the spider aloe) or is sometimes listed as *A. arborescens* '**Dwarf**'. This is a much smaller (3' spread) but clumping aloe. During winter a clump of plants produces many deep orange to red flower spikes.

*Aloe brevifolia* freely offsets forming numerous small rosettes of 12" leaves with soft white spines, and a spike of orange to scarlet flowers. It develops into an attractive groundcover for a dry rock garden. The var. *depressa* has wider leaves. *Aloe* '**Dorian Black**' is a miniature cultivar, 4-6" with bright mint green flecks on a pale green background, and orange flowers on 18" scapes for much of the year. *Aloe x* '**Blue Elf**' is a medium size clumping hybrid aloe, to 2-3', with distinctive steel blue leaves, winter blooming with orange/red flowers. Another hybrid for the small garden is the impressive *A. 'Rooikappie*', unusual in that it flowers for much of the year, producing flat topped panicles of bright orangey red flowers. The

green leaves have a few white flecks and are often tinged red, and form a 12" wide rosette.

Where more space is available, there are numerous, impressive, large aloes from which to choose. The tilt head aloe, *A. speciosa*, varies from being shrubby to sometimes single stemmed – the latter more so in very open sites. It produces large, heavy rosettes (up to 4-5' wide) set at an angle to the stem. These consist of irregularly curved, bluish green leaves, the margins tinged pink and bearing small teeth. From winter into spring tall flower spikes form, appearing deep red at first as the buds mature, then pale green once the flowers open and finally dark orange when the anthers become exposed.

*Aloe excelsa* is another large aloe, but is none-branching, having a single tree-like stem to 10 - 14' bearing a rosette consisting of many long, curving leaves, 30" x 6", both surfaces spiny, rounded below with the upper surface having a deep V cleft. The stem is usually sheathed with the dried remains of old leaves. The inflorescence is a much branched panicle bearing many small orange to red flowers (national flower of Zimbabwe). *Aloe thraskii* is also non-branching, growing to 8 -10' with a rosette of highly recurved often glaucous green leaves. As the stem grows it too becomes clothed with the remnants of dead leaves. In winter several large, conical inflorescences appear. They are composed of many bright yellow to orange flowers, which together present a candelabra-like appearance.

*Aloe ferox* is a shrubby or sometimes single-stemmed aloe that can grow to 9', with large, dense rosettes of dull green lance-shaped leaves bearing prominent, reddish marginal teeth. Each inflorescence forms from late winter to spring, appearing as a long cylindrical spike composed of many small tubular bright orange to yellow flowers.



*Aloe ferox* flowering in December

Somewhat smaller, the coral aloe, *A. striata*, is a solitary, usually non-branching aloe, with a decumbent growth habit and a rosette of very attractive blue/green leaves, edged pink (more so if exposed to full sun). The true species has entire leaves (margins

totally devoid of spines), a useful means of distinguishing it from the hybridized forms more frequently offered for sale. A branched flowering stem bears numerous flat topped racemes of coral colored flowers, winter into spring. *Aloe prinslooii* is an attractive spotted, clumping aloe with conflicting reports as to ease of cultivation. It is from an area of South Africa with high summer rainfall (>30'), and would therefore be expected to adapt well to south Florida. It has broad deep green leaves with elongated whitish green spots and curved orangey red teeth. In winter a branched inflorescence composed of pale pink flowers is produced. Not as frequently offered for sale as other species, but worth trying in south Florida.

Grass aloes are a group of threatened small aloes found in open grasslands of eastern South Africa, less xeric than most other aloes, and requiring a somewhat more organically enriched soil. *Aloe cooperi* is the most often seen of these aloes in landscapes, producing two ranked rosettes of long narrow leaves (to 2'), green with marginal white teeth. Leaves are lost during winter in all but the mildest climates. During late summer 3' stems appear bearing green tipped, coral red flowers. This aloe usually produces offsets.

**Anacampseros (Portulacaceae)** Unusual, diminutive plants in the purslane family, with fleshy leaves often in a 4" rosette, some clump forming, others creeping, becoming mat-like. Many eventually form a caudex, quite out of proportion to the plants size. Many small stems arise from the caudex, some of which elongate and bear white, pink, red or purple flowers sporadically throughout the summer. The flowers are short lived, but unexpectedly large ( $\frac{3}{4}$  - 1") for such small plants. *Anacampseros* is readily propagated from seed, but is very slow growing, being usually offered for sale in 4" pots. They have been regarded more as container plants rather than as part of a landscape feature. Apart from a very free draining soil, they require little else except full sun exposure (some afternoon shade from hot summer sun is advisable). *Anacampseros* become dormant in winter and must not be watered. If you wish to try these plants in a dry rock garden add some crushed Miami limestone to the scree mix used as backfill.

**Beaucarnea (Ruscaceae)** One species, *Beaucarnea recurvata* is locally familiar as the pony tail palm. Plants in this genus are not palms, but closely related to dracenas, both of which are members of the Ruscaceae. Pony tail palms were for many years classified in the genus *Beaucarnea*, then later included with the *Nolina*, but have recently been removed and *Beaucarnea* restored. Both names will be seen in horticultural descriptions and plant catalogs.

Pony tail palms are commonly used in local landscapes, and will succeed without building a dry rock garden, providing they have a perfectly free draining soil in a location that does not flood. Although full sun is best, they can be grown with some shade, and have been used as interior plants where there is sufficient bright light. They make a good specimen plant for a dry rock garden if sufficient space is available. Slow growing to about 20', they develop a large, deeply furrowed caudex and a canopy of long grass-like foliage. Flowers are imperfect (separate male and female), and are found only on very mature specimens (at least 20 – 25 years). Flowers of one sex are sometimes shed, so pollination may not be successful. Seed is usually imported from Mexico.

Apart from the familiar *B. recurvata*, there are other less frequently used pony tail palms such as *B. pliables*, which usually produces multiple stems from the caudex. *Beaucarnea stricta* is more upright and produces less branching compared to the previous two species, the canopy consisting of stiff leaves that are blue/green and radiate out from the branch tips.

**Bromeliads (Bromeliaceae).** Although often thought of as plants requiring at least partial shade, there are bromeliads that will thrive in full sun. Some of these plants exhibit excellent drought tolerance, and have acquired characteristics typical of succulents (e.g., thickened, fleshy leaves). Species such as *Dyckia* and *Hechtia* develop an extensive root system, unlike their epiphytic cousins, and are found in arid areas of South and North America respectively. From a cursory glance these bromeliads, with their stiff, spiny margined leaves could be mistaken for an agave. However agaves usually have more fibrous leaves and lack the scales (minute hair-like outgrowths, trichomes) which cover the bromeliad leaf surface. A third group of xeric bromeliads, *Puya* spp., are found mainly in the high Andean deserts of South America where they have adapted to extremely dry, full sun conditions. They are not as common in cultivation as either dyckias or hechtias, but are noted for their attractive inflorescence made up of many very colorful, campanulate or tubular flowers. It can be several years before one of these bromeliads commences flowering. Many puyas have short stout stems, and all have dense rosettes of narrow leathery leaves with at least some marginal spines.

Dyckias are stemless with a rosette of stiff, spinose leaves, covered with scales which give the foliage a grayish cast. In spring/summer a short scape (though in some species it can grow to about 3') emerges. This bears an inflorescence that is sometimes branched, and composed of many small, yellow to orange flowers. Like aloes,

the flowers attract hummingbirds. Mature plants produce offsets (pups), which can be removed for propagation.

Hechtias are similar to dyckias, except the leaves are often recurved and not always armed. The inflorescence is frequently branched, with many small, usually greenish-white flowers that are functionally imperfect – functional male and female flowers are on separate plants. Hechtias are hardier than dyckias, able to withstand freezing temperatures. When planting either species in a dry rock garden use the modified scree mix as backfill, increasing the amount of sphagnum peat and coarse sand/grit in the mix and reducing the proportion of larger sized aggregates. Add some crushed limestone when planting hechtias. During winter, water only when temperatures are above 80°F, and in late spring/summer during extended periods of hot dry weather. As with all bromeliads, never use copper based fungicides to control any disease problem that might arise.

Dyckias are more widely cultivated, possibly because of their colorful inflorescence. The pineapple dyckia, *D. brevifolia*, has dull green leaves and a simple inflorescence of many bright yellow flowers. The cv. 'Moonglow' has all yellow new leaves that turn dark green from the tips as they age. *Dyckia cinerea* has very long, narrow leaves covered with dense grey scales and scattered marginal spines; *D. choristaminea* is similar in appearance but smaller. Clumps make an effective ground cover in a dry rock garden. *Dyckia echolirioides* is a larger species, up to 6' when in flower, with a rosette of narrow, triangular, 1 – 3' leaves, the upper side glabrous, the underside grayish green. The inflorescence is either simple or much-branched, with numerous red/yellow flowers; var. *rubra* has deep red flowers. One of the most attractive of the species plants is *D. marnier-lapostollei*, a very slow growing species with striking silvery scaled leaves, bearing prominent teeth tipped with curved spines. The inflorescence consists of many yellow flowers.



*Dyckia* spp.

There are numerous hybrids/cultivars available, usually from specialist growers: *Dyckia* 'Cherry Coke' is clump forming, individual plants growing to a width of 2'. Foliage becomes deep purplish red in full sun, with spikes of orange flowers on 3' stem; *Dyckia* 'Cherries Foster' is a cross between 'Cherry Coke' and *D. fosteriana* with rich chocolate brown and maroon leaves and a spike of orange flowers.; *Dyckia* x 'Picante' has chocolate to purplish red leaves with the spines and leaf underside silvery. The inflorescence consists of many orange flowers; *Dyckia* 'Nude Lady' is a spineless cultivar with stiff, bright green leaves; *Dyckia* 'La Roja' has thin, silvery leaves and red flower spikes on a 3' stem.

Hechtias are found growing in arid areas of Mexico as well as in scattered areas to the immediate north and south, usually on

limestone outcrops. The Texas false agave, is the only species truly native to the US, and is so named because it resembles the native agave, *A. lechuguilla*. It can be readily distinguished from an agave when in bloom by the flower stalk, which emerges to the side of the leaf rosette, and the bright red leaf blotches that are especially conspicuous during periods of prolonged hot dry weather. The inflorescence appears late winter into spring on a tall scape and consists of many fragrant white flowers.

*Hechtia argentea* is clump forming, each plant a rosette of spiny edged, long, narrow, ash grey leaves; *H. caerulea* has glaucous, spineless leaves and unusual pale blue flowers; *H. rosea* leaves have a dense covering of scales, becoming rust/red in full sun, flowers are rosy pink on a red stem

There are other bromeliads, mostly non-succulent, such as *Aechmea*, *Alcantarea*, *Orthophytum* and *Pitcairnia* that will take full sun. Some light shade is usually beneficial, as well as regular watering to ensure the soil remains just moist. From the high deserts of NW Argentina comes a group of small clump forming bromeliads formerly known as *Abromeitiella*, but now part of the genus *Deuterocohnia*. These are rare in cultivation but well adapted to the dry rock garden, where they form attractive mossy mounds with showy flowers.

**Crassula (Crassulaceae)** A large group of succulents that range from low spreading diminutive plants to those with a more shrub-like growth habit. All are grown for their interesting form, attractive foliage and in some instances showy flowers. The leaves are usually sessile (leaf stems absent), small, round and fleshy, often tinged red, sometimes glaucous. Flowers are small, tubular to star shaped and white to pink or red, and clustered at stem ends. Flowering, depending on species, can be from late fall to early summer, but is not always reliable. Plants need to be mature, and receive sufficient exposure to sun, and for *Crassula ovata* at least flowering seems to be stimulated by shortening day length and lower night temperatures.

In south Florida, crassulas should be situated in full sun, though some light summer shade is acceptable. Place them in the dry rock garden in late fall and use the modified scree mix as backfill. Handle crassulas with care when planting as the leaves easily become detached, especially if the plant has become excessively dry. Crassulas exhibit varying degrees of dormancy during summer and in south Florida should not be watered. At this time they may not be as attractive – there can be some leaf drop, and stems are more likely to show signs of disease. Any rotted stems should be promptly removed. Most

#### *H. texensis*

(only male plants known); *H. lundelliorum* produces clumps of long weeping leaves (most effective planted at the edge of a rock ledge when grown in a dry garden); *H. tillandsioides* has lax narrow leaves (resemble those of bromeliad genus Tillandsia), and a spike of pale pink flowers.

*Puya raimondii* (reputed to be the largest of all the bromeliads) produces a 27' flower stem and leaves up 6', but is rarely seen in cultivation – like an agave it takes many years to flower, after which the plant dies. More readily available are *P. alpestris* (sapphire tower), notable for the unusual metallic blue-green flowers, *P. venusta* which has silvery grey, serrated, spiny margined leaves and waxy purple flowers with deep red bracts, and *P. coerulea* with leaf undersides covered with grey scales

active growth occurs late fall through spring, though the plants will cease growing during the coolest weather of winter. This is another time at which they should not be watered. Water only during prolonged hot dry periods in spring - the leaves will lose turgor/appear wrinkled if the plant is stressed. During late fall provide a light application of a low nitrogen fertilizer. There is little need to prune crassulas, except to remove diseased stems or for propagation. Any pruning that is required is best done immediately after the plant has flowered rather than late in the year as this will prevent further flowering.

The jade plant, *C. ovata*, is popular as a container plant. It can also be an agreeable addition to a south Florida dry rock garden, though not at its best during the hot wet months of summer. Plants should eventually grow to about 18 -24", with many thick, brown, branching stems, and small, fleshy, shiny leaves. Mature plants produce tiny, star shaped flowers in winter. There are a number of cultivars: widely used as container plants, but their usefulness as rock garden plants is uncertain: 'Gollum' is a dwarf form with tightly rolled leaf edges, 'Hobbit' is similar to 'Gollum', but lacks the rolled leaves; 'Tricolor' has variegated slightly twisted leaves, marbled with white and yellow, 'Variegata' has yellow foliage seen to best effect with some shade. There are other cultivars with variegated leaves that require cool temperatures, correct light exposure and limited fertilizer application in order to develop optimum leaf patterning.

*Crassula. arborescens*, silver jade plant, is sometimes confused with *C. ovata* but has larger, more rounded leaves with a bluish gray bloom and red margins. Under suitable conditions this becomes an attractive much branched shrub for the dry rock garden, but disease problems are a risk during the hot wet summer months.

*Crassula perfoliata* produces an upright stem with little or no branching, bearing spirally arranged, opposite, blue green, triangular to lanceolate, blunt pointed leaves. The small, white to red flowers appear in late summer as a branched, flat topped inflorescence. A number of varieties are available, of which *var. falcata* (the propeller plant) is most widely grown. The name propeller plant refers to the leaves on this variety which compared to the species have a flat surface and are curved like a sickle. The inflorescence is especially showy with flat heads of brilliant red flowers.

For other plants in the Crassulaceae, see separate entries for *Aeonium* and *Kalanchoe*.

***Dasyliirion* (Ruscaceae)** Formerly grouped with yuccas, which they resemble, dasyliirions are now part of the Ruscaceae, a plant family that includes beaucarneas (ponytail palms) and dracenas. Dasyliirions are native to the arid areas of the US south west and Mexico, are slow growing and very drought tolerant. The plants can be stemless, but more often slowly develop a short stout trunk (may be underground), from which an impressive tuft of many long, stiff, narrow leaves emerges (thus the common name grass trees). The leaf margins usually bear hooked spines, but unlike yuccas, the leaf tip is unarmed (either entire or twisted and fibrous). Flowering occurs only on mature plants in summer, the inflorescence (a long narrow panicle) being borne on a tall stem (to 14'). Individual flowers are small, white to yellow, with separate male and female plants (dioecious). Unlike agaves, dasyliirions do not die after flowering, nor do they produce offsets. Propagation is from seed, necessitating the presence of both male and female flowering plants.



In a dry rock garden dasylirions should be planted in full sun. Use the modified scree mix as backfill to optimize drainage.

Figure 2 Immature *Dasylirion wheeleri*

One of the best known of these plants is *D. wheeleri* (desert spoon), which eventually develops a tree-like form with a trunk to 4' bearing a large, spheroid head of many 2 - 3', narrow, stiff, grey/green leaves. The leaves are twisted with finely serrated, spiny margins, the common name desert spoon referring to the shape of the basal part of the leaf when it is removed from the plant.

*Dasylirion longissimum* (Mexican grass tree) grows taller, stem to 10', and has much longer (to 4'), four angled leaves. Unlike desert spoon the leaves lack spines.



***Euphorbia* (Euphorbiaceae).** It would be difficult to envisage a dry rock garden without at least one or two succulent euphorbias. They range from dwarf, cushion forming plants such as *E. atrispina*, to squat, dwarf succulents such as *E. obesa*, or the sprawling tangle of spiny stems of *E. inermis* or *E. milii*, to the large cactus-like euphorbias (e.g., *E. abyssinica* or *E. ingens*). Characteristic of all euphorbias are the greatly reduced flowers, which have neither sepals nor petals that form part of an inflorescence termed a cyathium. This consists of one or more male flowers, reduced to one or more single stamens, joined to a single style (the female flower) surrounded by a cup like structure (involucre) made up of small bracts and glands/nectaries. This is subtended by petal like bracts (cyathophylls) which provide striking color to the inflorescence of plants such as *E. milii* and *E. punicea*.

A second characteristic, one especially associated with the succulent euphorbias, is the copious amount of white milky sap (latex) that exudes from cut/damaged surfaces. The latex of many euphorbias was used as a fish poison in Africa for many hundreds of years. More recently there has been interest in exploiting the potent molluscicidal properties of latex from species such as *E. milii* as a means of controlling snails. This latex is a severe skin irritant and can cause serious eye injury as well as being poisonous if taken internally. It has been found to contain compounds known to have carcinogenic properties

(phorbol esters). When working around succulent euphorbias in your dry rock garden take extra care, especially if you remove cuttings for propagation. The presence of stout spines on many of these plants should act as a warning not to come too close.

One other point of information concerns the possibility of confusing spiny, succulent euphorbias with cacti. The easiest means of distinguishing between the two is to lightly cut the stem. When a cactus is cut there is clear sap, not the white latex found in euphorbias. Visually, apart from obvious differences in flower structure, the other principal feature is the absence of areoles in euphorbias (as well as other cactus like succulents such as various aclepidids). Areoles are cushion-like areas of meristematic tissue (specialized buds) found on the stems of all cacti from which arise hairs or spines and either a flower or a new stem/off-set. Those areoles that form flowers become callused and will not produce new stems or off-sets. When a spine is detached from a cactus it will break off with only the areole attached. It is more difficult to cleanly remove spines from succulents such as euphorbias without also removing much of the surrounding stem tissue. In the succulent euphorbias discussed below, the spines often develop from old flower stalks (peduncles).

Unless otherwise noted succulent euphorbias should be planted in full sun, using the modified scree mix as backfill. Try to plant during extended periods of warm dry weather (e.g., late fall/early spring), avoiding times when the soil has been inundated with water. This is especially so for species having swollen/caudiciform stems. Water within 7 – 10 days of planting (the container potting mix will should contain sufficient moisture). The larger cactus like species should be considered only where there is sufficient room for them to develop safely. Pruning will rarely be required. When necessary (removing a damaged or diseased branch, or cuttings for propagation) wear gloves, a long sleeved shirt and eye protection. These precautions are especially important when pruning large cactus like specimens.

The following selection of succulent euphorbias is far from exhaustive, but is a representative cross section of the range of plants currently available. There are dwarf to sub-shrub species, somewhat larger plants resembling small cacti (e.g., *Gymnocalycium*, *Ferocactus*), a more restricted group of shrub-like specimens with showy flowers as well as the large cactus like succulent euphorbias. Most difficulties will probably involve growing some of the dwarf species that are more prone to rot.

***Euphorbia aeruginosa*** is a low growing (to 12") shrubby plant, branching below or just at soil level from an underground caudex. The striking, verdigris colored stems are somewhat angular and bear prominent 3/4" red spines, above which are a pair of much smaller spines. In late spring the stems are covered with yellow cyathia. ***Euphorbia aeruginosa minor*** is smaller

with thinner stems, and **var. *nova*** has thicker less spiny stems.

Somewhat larger, but also branching from the base, ***E. baioensis*** produces thicker, fleshy, more rounded stems, to about 12 x 1", light olive green with many 1/2" red to black spines and smaller prickles. The stems are upright to slightly decumbent, and produce small cymes of tiny yellow cyathia.

Quite different to the above cactus-like species is *E. cap-saintmariensis* a miniature (to 12") much branched shrubby plant. The stems are unarmed, smooth, off-white to tan with small crinkled leaves at the tips. Branching occurs just above the soil line from a 2-3" underground caudex which may be partially exposed in some specimens. The plant responds well to increased summer moisture, but should be kept drier during winter. *Euphorbia ambovombensis* is similar in general appearance except for having a larger caudex, and stems with an attractive rough warty surface.

For an impressive floral display, *E. inermis* produces many fragrant, white to yellow flowers in summer, peduncles (flower stems) becoming short spines. Numerous thin 12" branches are formed from the margin of a short swollen stem (caudex). This is one of a group of succulent euphorbias that are sometimes grouped as the medusae. They are characterized by a short distinctly swollen main stem (caudex) from which arise many long, thin, snake-like fleshy stems. The best known is Medusa's head, *E. caput-medusae*, which is similar to *E. inermis*, but somewhat larger. These and other medusoid euphorbias are dormant during cool winter weather, and also during late summer at which time the risk of stem rotting increases.

One popular, dwarf succulent euphorbia, at least for use in containers, is *E. obesa* (living baseball). The stem is olive green with faint purple bands, ribbed, almost globose, eventually becoming more cylindrical. *Euphorbia symmetrica* is similar in appearance, though smaller than *E. obesa* and can be distinguished by having more than a single peduncle per inflorescence eye. Another small columnar species, *E. horrida* (African milk barrel), develops a ribbed stem that can be cylindrical to almost globe-shaped. The ribs are most noticeable on taller, columnar plants. It has been suggested that these forms may be the result of natural hybridization with related species. The prominent spines (to 1½") are derived from old peduncles, the cymose inflorescence

being composed of three cyathia with plum colored accessory glands.



*Euphorbia lactea* 'Cristata' with red crest.

Of the cactus-like shrub euphorbias, *E. lactea* (milk stripe euphorbia, candelabra cactus) is one of the most widely grown, reaching a height of up to 12'. Provide sufficient space to avoid accidental contact with the spines and especially the poisonous latex. Unusual dwarf forms with stems that develop frilled, crescent shaped ridges, (cristate forms, *E. lactea* 'Cristata') are also available. Of particular note are cristate forms with variegated crests, such as 'White Ghost'. Recently introductions from Thailand having crests in various colors, ruby, pink, purple, orange and yellow among others, have become available in N. America. These are grafted onto *E. nerifolia* (see below). For 'White Ghost' at least, color is improved with some shade from hot afternoon sun.



*Euphorbia stenoclada*



Red form of *Euphorbia trigona*

Another colorful plant in this group is the red form of the cathedral cactus (*E. trigona*), sometimes known as 'lucky plants', with small wine red leaves, which are lost during extended periods of dry weather. The stems are upright, prominently three-four angled and mottled white with a diffuse redness. Where plants do not receive full sun the red color fails to develop fully.

The more shrubby *E. stenoclada*, commonly known as silver thicket, is so named for the very attractive silvery to bluish grey, flattened stems. In time it grows into a stiff, much branched, leafless 5-6' shrub, the stem tips developing into a formidable array of sharp thorns (cf. most other succulent euphorbias that have stipular spines).



*Euphorbia tirucalli* 'Sticks on Fire'

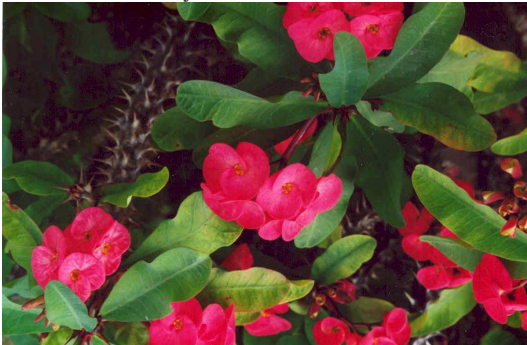
The pencil tree, *E. tirucalli*, is large (at least 20') with rubbery, spineless, almost leafless stems. This plant should be familiar to long time residents of Miami-Dade, however it is rarely used now, probably because of the danger posed by the caustic latex. A more attractive shrubby cultivar sold as 'Sticks on Fire' has many thin stems with orangey red tips. Again, exercise caution in the placement, and any subsequent pruning of this plant.

More cactus-like in its' appearance, the cow horn euphorbia (*E grandicornis*) branches very close to the ground into several three-angled stems armed with paired 2½" spines to form a 6' candelabra shaped plant. The stems are segmented; grey/green, with each of the three margins becoming thickened and horny.

Whereas foliage is absent or much reduced in the large cactus like euphorbias described above, *E. nerifolia* (Indian spurge tree) has large, stiff, persistent, spirally arranged leaves, usually crowded toward the branch tips. This can be maintained as an attractive shrub (poisonous latex, take great care when

pruning) in a large, dry rock garden. To avoid *E. nerifolia* from becoming too leggy, grow in full sun with a twice -yearly application of fertilizer, pruning back as necessary in early spring. There is a cultivar with variegated crested stems, '**Variegata Cristata**', not commonly available, but much slower growing and more suitable for a smaller garden.

Of the succulent euphorbias grown for their color, crown of thorns (*E. milii*), and especially the hybrid forms such as *E. x lomi* (*E. milii* x *E. lophogona* hybrids), are most familiar. There is particular interest in the '**Poysean Group**', combining attractive foliage with greatly enlarged, very colorful cyathophylls, which are in flower for most of the year<sup>13</sup>.



*Euphorbia x lomi* 'Poysean Group'

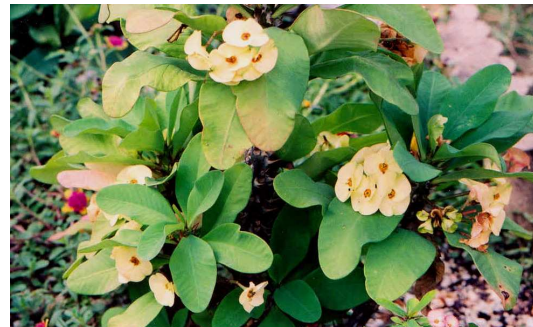
In addition to crosses with *E. lophogona*, *E. milii* freely hybridizes with other related species both in the wild and under cultivation. Several growers have produced such crosses (e.g., x *E. beharensis* '**Cranberry Cowboy**' and x *E. Decaryi*, *E. 'Nat Wong*'). Though of limited availability at present, these and future crosses are worth seeking out for potential landscape use.

There are several interesting *E. milii* varieties of unknown parentage One such is *E. milii* var. '**Siegfreidii**' which has sturdy, smooth, woody appearing dark tan stems and large leaves with often with a purplish underside.

There are other succulent euphorbias that can add color to a dry rock garden, *E. viguieri* being particularly attractive. This is a small, 3-4' shrub, with a green, clavate (club-shaped), six-angled stem which branches and bears persistent spines. The long narrow leaves are confined to the branch tips, and have a vivid red base and a distinctive pale green mid-rib. The cyathophylls are borne on a prominent stalk, and are pale yellow tinged red.

*Euphorbia geroldii* resembles crown of thorns with its' large, colorful cyathophylls (brick red), but differs in having no spines. It has larger, more glabrous leaves, and can grow to 12', but should be pruned to prevent it from becoming too leggy. Use less gravel and more coarse sand and sphagnum peat in the backfill – *E. geroldii* should have some light shade and will benefit from supplemental water during prolonged hot dry weather.

*Euphorbia gottlebei*, grows to about 4', with a form resembling crown of thorns. However it is much slower growing, with quite different foliage, the leaves being thin and wispy almost grass like. The attractive flowers are on long stalks with pale coral to red cyathophylls. Except for periods of cool weather *E. gottlebei* should be watered every 2-3 weeks during winter, to prevent the soil from becoming too dry.



*Euphorbia x lomi* 'Poysean Group'

<sup>13</sup> The publication '*Euphorbia milii*, Crown of Thorns' can be downloaded from <http://miami-dade.ifas.ufl.edu/publications.htm> for detailed information on crown of thorns including the *E. x lomi* 'Poysean Group'.

**Fockea (Apocynaceae).** This is a small genus of caudiciform succulents within the Apocynaceae, most of which have thin, often twining stems, small leaves and rather insignificant though sweetly fragrant flowers. Usually found in cultivation as container/bonsai plants, their appeal centers on the unique character each specimen assumes as the caudex (greatly swollen stem) develops. The caudex can assume many interesting forms, growing to a width of 1 - 2' and as much as 3' in length. It varies from pale green to various shades of brown, becoming warty with age. Much of this development occurs below ground, and it is usual to transfer well established seed grown plants to a wide, shallow, unglazed clay pot, eventually raising them after 2-3 years to expose the caudex. It is advisable to keep the exposed caudex shaded from full sun, and to provide some type of support for the numerous thin stems. Fockeas are extremely difficult to grow from cuttings, and since the flowers are self sterile, two plants are needed if you wish to attempt producing seed. If you decide to try setting out Fockea in a dry rock garden provide at least some partial afternoon shade for the caudex, e.g., an adjacent large boulder, with the stems fully exposed to the sun.

Most widely available is *F. edulis* which should retain most of its foliage throughout winter in Miami-Dade – this species will survive a light frost. Most growth occurs during late spring and summer, at which time the stems can be thinned out if they become too untidy. During the winter fockeas become dormant, rarely requiring watering (this is when they are most prone to rot). During this period water every 4 -5 weeks only if plants retain foliage and temperatures remain above 75°F – otherwise keep dry. Of the other available species, *F. multiflora* appears to be less liable to rot, at least under S. California conditions, and develops the largest caudex. Sometimes known as the vegetable python, this species grows as a liana in the dry savanna forests of southern Angola, the stems up to 30' in length and as thick as 5-6".

Closely related to fockeas are the Rhaphionacme, also vining plants, but developing a smaller though very attractive caudex. Especially appreciated by bonsai enthusiasts, they require somewhat more shade than fockeas.

**Furcraea (Agavaceae).** Similar in appearance to agaves, they form large rosettes of broad to narrowly lanceolate leaves with serrated to spiny margins and a stiff blunt tip. The leaves are borne on a short thick stem which, depending on the species, can grow up to 4-5'. Like agaves they are monocarpic, flowering once after a period of at least 5 – 15 years, then dying within a year. The inflorescence is produced on a tall, erect stalk, and comprises a panicle of pendant, white to green, strongly scented flowers. Seed is rarely set, however bulbils form at the base of the style as each flower fades. On contact with soil, these readily take root to produce new plants, and are the principal means of propagation.

Apart from being less tolerant of cold temperatures than agaves, conditions for growing furcraeas are very similar. In Miami-Dade, winter temperatures are not a limiting factor. Provide an open site with gritty, free draining soil, full sun (though they can take some light shade, especially in the summer).

The most commonly grown species is *F. foetida*, the giant false agave, isolated specimens of which have been reported growing wild in Miami-Dade. A large, usually stemless plant that requires plenty of room, with a rosette of 6' dull green, fibrous leaves, with scattered marginal spines. Of much bolder appearance is the cv. 'Mediopicta' which has striking, variegated leaves with a creamy yellow center and green margins, and the added advantage of no spines.

Somewhat smaller and with a short trunk, *F. selloa* (wild sisal) has bright green 3' leaves, the margins armed with curved brown spines. This species is also listed as growing wild in Miami-Dade. *Furcraea selloa* var. *marginata* has leaves with a thin white to cream border, and makes a more attractive item for landscaping. *Furcraea roezlii*<sup>14</sup> is particularly impressive forming a large rosette of long narrow blue/green leaves, atop a stout trunk that can exceed 10'. Older leaves hang down almost parallel to the trunk, eventually forming a brown skirt around the trunk (cf. a booted palm).

***Hoodia, Huernia*** (Apocynaceae) see Stapelia below

***Jatropha podagrica*** (Euphorbiaceae). Commonly known as the gout plant or Buddha's belly, this succulent is not seen as often in local landscapes compared to 20 -30 years ago. It is grown for the swollen, bottle shaped stem and the flat topped heads of attractive coral red flowers. The leaves are large and dissected into 3-5 lobes, resembling those of an edible fig tree. In order to develop a specimen with a fully swollen stem, first grow the *Jatropha* in a container providing partial shade and frequent pruning. In the landscape, plant in full sun, then provide a light application of a slow release fertilizer in late spring. Mature plants can be expected grow to about 6'. *Jatrophas* like so many other succulent plants in the Euphorbiaceae, contain poisonous white latex.

There are other pachyform *jatrophas*, but these are mainly grown as subjects for container/bonsai use, and are not as attractive when in flower.

***Kalanchoe*** (Crassulaceae). These are familiar to most local gardeners as colorful bedding plants for use during late winter/spring (*K. blossfeldiana* and cultivars). There are in fact more than 120 other species, of which those of horticultural interest are usually grown for their fleshy, attractively marked foliage. The leaves are frequently sessile, smooth or tomentose, often covered with a fine pale blue to grey farina. They vary from low growing herbaceous plants to small shrubs and even a few climbing species. Many of those grown for their foliage also produce showy flowers from late fall into spring. These are short day plants, flowering being initiated as days shorten (8 – 10 hours).

Grow in an open, sunny area, though some species (especially those with thin hairy leaves) gain from afternoon shade during late spring to summer. Species with heavily felted leaves are more tolerant of full sun and drought. In general however *kalanchoes* can tolerate more moisture than other members of the Crassulaceae. The basic scree mix should be amended - gritty, but with additional peat and potting mix and less large size aggregate. Established plants

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<sup>14</sup> Some authors regard *Furcraea roezlii* to be a synonym of *Furcraea. bedinghausii*.

do not require regular watering, except during prolonged periods of hot dry weather.

Kalanchoes are easy to propagate from stem or leaf cuttings, seed being unreliable. Powdery mildew may be a problem during warm dry weather (spring or late fall)

There are several species that can be used as ground cover in a dry rock garden.

***Kalanchoe luciae*** forms offsets made up of rosettes of round, paddle shaped, blue-green leaves resembling clam shells, with margins suffused a rosy apple red. The degree of red coloration is dependant on exposure to sunlight. This species is sometimes confused with ***K. thyrsoiflora*** '**Bronze Sculpture**'<sup>15</sup>, which also has similar red-margined leaves, though in this instance the leaves are not quite as round and have more of a chalky bloom. In addition, the latter species also develops a much more distinct stem to about 2-3'.

Another species to develop red margined leaves is ***K. longiflora*** which has olive green to grey green leaves, the color intensity again depending on exposure to sun. The **var. *coccinea*** has far more intensely red leaves.

Also useful as a bedding plant is ***K. grandiflora***, distinguished by upright growth, waxy, blue green foliage, and fragrant, bright yellow flowers late fall to early spring. ***Kalanchoe orygalis*** has leaves that are olive green with entire margins and new growth covered with numerous minute golden hairs. The elongated inflorescence is composed of erect yellow flowers. This is more drought -tolerant and slower growing than most other kalanchoes, but eventually reaches a similar height of about 3'. ***Kalanchoe marmorata*** is another medium size species, more decumbent than ***K. grandiflora*** and with white flowers. The glaucous leaves are larger, green with conspicuous mauve to purple blotches which become more prominent with increasing exposure to full sun.

Of the larger shrub-like kalanchoes, ***K. beharensis*** (felt plant) is best known as a popular container plant, grown for the

arrow shaped leaves densely covered with small brown hairs. This is a slow growing species, growing up to 18' in its native Madagascar, but much less (about 12') in local outdoor cultivation. Eventually forming a much branched tree/large shrub, it can easily be maintained as a medium size shrub with occasional pruning. The close spacing and raised nature of the old leaf scars give the trunk and larger stems an interesting gnarled appearance. The leaves are big up to 14" long x 10" wide, grey green to olive green, becoming covered with a dense pile of rusty brown hairs in strong sunlight. The petioles are prominent, unlike the previous kalachoes, stout and up to 4" long. Flowering takes many years, occurring only when the plant reaches maturity. There are a number of cultivars and hybrids: '**Fang**' has triangular leaves with rusty brown margins and tooth-like outgrowths on the leaf undersides; '**Minima**' is a dwarf plant with smaller more oblong grey green felted leaves; '**Monstrose**' is another dwarf plant with very curly leaves; ***K. beharensis* x *K. millottii*** '**Oak Leaf**', felted, grey green leaves assuming the form of an oak leaf as they mature and becoming bronze around the margins in full sun; ***K. beharensis* x *K. tomentosa*** '**Rose Leaf**' has smaller leaves tinged pink on upper surface, the lower surface grey.

Another arborescent species that can make an attractive contribution to the landscape is ***K. hildebrandti***, commonly known as silver spoons. Growing up to 15', it is especially admired for the striking foliage. Individual leaves are small, round and thick with a distinct petiole, and appear silvery white due to a thick covering of tiny hairs.

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<sup>15</sup> A similar plant is sometimes listed as *Kalanchoe thyrsoifolia*.



Closely related to kalanchoes are the bryophyllums, which together formed the genus *Kalanchoe*, until *Bryophyllum* was recently resurrected as a separate genus. The bryophyllums can be distinguished from kalanchoes by the pendant flowers (upright in kalanchoes) and the habit of forming plantlets on the leaf margins (this is rare in kalanchoes). This latter habit contributes to their tendency to become weedy, consequently they are rarely used as landscaping plants. In Miami-Dade County, *B. pinnatum* (commonly known as cathedral bells or life plant) is regarded as invasive, and is therefore on the county's list of restricted plants.

***Monadenium* (Euphorbiaceae).** A group of mostly low growing succulents (there are a few shrubby, arborescent species) found in tropical E. Africa. Most of the species in cultivation are admired both for their interesting form (some develop a caudex) and attractive flowers. They are similar to the succulent euphorbias described above, the main difference being in the arrangement of the inflorescence. The cyathia<sup>16</sup> are placed laterally on the stem above which are located a pair of adjoining, cupped, hood-like cyathophylls (bracts). The cyathophylls can vary from a yellowish green to more showy colors including pink, red or orange. The stems can be thin and smooth (more so with the caudiciform species) or thick, ridged, tessellated or warty, and often spiny. The thick fleshy leaves are lost during winter dormancy. Flowering occurs in fall (may be scattered flowers at other times) after which the plant becomes dormant.

Most experience is with container grown plants, many of which are eventually raised to display the underground caudex. Before attempting to grow monadeniums in a dry rock garden consider the following points. They are very susceptible to frost damage which should rarely be a problem, especially for areas within 2-3 miles of coastal Miami-Dade. More importantly they will rot if over watered during winter dormancy. It is best not to water at all during winter. Most monadeniums prefer heat (except for a few high altitude species) and bright light rather than full sun exposure. In Miami-Dade try providing light shade at least from hot afternoon sun. Shade is far more important if the plants are raised to show off the caudex.

Monadeniums are easy to propagate from cuttings, and therefore relatively inexpensive so there is little to be lost in experimenting with one or two plants in your rock garden. Like the succulent euphorbias, they produce copious amounts of irritant, poisonous latex when cut or injured – exercise care in their placement and cultivation. The following are available from a number of mail order sources.

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<sup>16</sup> Term used to for the reduced flower unique to Euphorbiaceae - see previous description under succulent euphorbias on p. 22.

*Monadenium rubellum* has thin sprawling stems that are ridged, glabrous, with purple to red streaks. The leaves are narrow, mottled red (more so in bright sunlight) and the flowers (most in evidence during fall) a delicate pale pink. Crowded stems need to be thinned out to improve air circulation. Another sprawling species, *M. coccineum*, is appreciated for the bright red flowers. The stems are thin, glabrous and unarmed, often branched with small, keeled fleshy leaves. *Monadenium ritchei* has thicker

(1¼”), warty, spiny, stems, decumbent with little branching, and flowers forming at the stem tips in fall. The **ssp. nyambense** has an inflorescence that is a more vibrant pink. From its use as a house plant, the species has a reputation for being especially susceptible to rotting when over watered. *Monadenium schubei* is somewhat larger, with thicker (to 2”), more erect stems, bearing prominent tubercles and stiff spines. Pale pink flowers form at the stem tips in the fall

***Pachypodium*** (Apocynaceae). The larger species are often referred to locally as Madagascar palms, though they are in no way related to palms, being members of the Apocynaceae and close cousins of the desert rose. Most species are found in Madagascar, with a lesser number in southern Africa. Those from Africa are hardier than species from Madagascar, able to withstand lower winter temperatures. Compared to adeniums (desert rose), pachypodiums are more variable in shape and size, possess prominent spines, and are generally not quite as showy when in flower. Like adeniums they have swollen stems (pachycaulous), and many of the smaller species develop a pronounced caudex. They also resemble adeniums in that most are self infertile (see below), and successful fertilization requires at least two plants for cross pollination. Pachypodiums can range from tree like species, with a single tall swollen trunk, to more squat shrubby forms, and those with an extensive underground caudex.

In general appearance the leaves are similar to those of adenium, except for exhibiting a much greater range of size and shape. In the wild, pachypodiums lose most of their leaves with the onset of cooler dry winter weather. In cultivation, where conditions permit, plants will often remain in leaf throughout winter. Pachypodiums, in contrast to adeniums, will only flower when mature, up to 10 years for a slow growing species. Grafting (see below) can speed up the process. Branching of stems occurs only after they have flowered. The flowers resemble those of adeniums being campulate to salverform, though showing more variability as to form and size (see species descriptions below). Flower colors range from white, yellow, to red and various shades of pink. The fruit takes the form of a pair of curved follicles, similar to those found in *Adenium* but larger. Ripening takes several months at which time the follicle splits from the distal end to release oblong seeds with a tuft of hairs at one end.

Propagation is from seed, if available, or more commonly from cuttings which can be difficult with species that produce only a few large branches. Stem cuttings are best taken in late winter when there is less risk of them rotting. Sections of stem between 2- 4” are most successful, and should be first left for 4-5 days to allow the cut end to dry out before planting. Dip the cut end in

rooting hormone/fungicide and then insert the cutting no more than ½” into a gritty potting medium (60 -70% Perlite plus Canadian peat). Cuttings from the exposed fleshy roots of *P. succulentum* have also been used as propagating material. Grafting, using a vigorously growing rootstock such as *P. lamerei* is possible and is especially beneficial for a slow growing rot prone species such as *P. brevicaulis*.

In a Miami-Dade dry rock garden pachypodiums should receive full sun. As backfill provide a porous but fertile soil, consisting about 70 % small aggregate (poultry grit, coarse sand and Perlite), with the remainder composed of organic material such as Canadian peat and a compost-based potting mix. For tree like pachypodiums (*P. geayi*, *P. lamerei* and *P. rutenbergianum*) that require more water, the amount of organic material can be increased to 40% of the total. Apart from *P. namaquanum* which is dormant from early summer to late July, pachypodiums are winter dormant at which time they should only be watered when temperatures remain above 70°F, and the plant retains foliage. The pachypodiums described below have been arranged according to size.

The three best known tree-like species are all from Madagascar, *P. lamerei* being most widely grown. This is occasionally seen in local landscapes where it is known as the Madagascar palm. This is a fast growing pachypodium reaching about 15’ in cultivation, but up to 24’ in the wild. The trunk is smooth, shiny and covered with numerous stiff spines, becoming cigar shaped, tapering toward the apex where it forms a number of short stout branches. Branching is dichotomous (repeated forked branching), and loose rosettes of long narrow leathery leaves are found at the end of each branch. During the warmer months of the year white salverform flowers with a yellow eye appear near the branch tips. Flowering usually begins when young plants reach about 3 – 4’.

Less frequently seen in cultivation and not quite as easy to grow is *P. geayi*, also from Madagascar. This species is similar to *P. lamerei*., differing in being taller (up to 30’ in the wild) and having the surface of the spiny trunk covered with a light grey felt. The leaves are longer and thinner compared to *P. lamerei* (to 15”) and are covered with short fine hairs . The flowers are white but smaller and occur in a much more branched inflorescence than *P. lamerei*.

The third and final tree like species, *P. rutenbergianum* is the rarest of the three in

cultivation. Because of the thinner trunk it is viewed by some as less impressive, though it does have large attractive white flowers. There are three even less common varieties of which *P. rutenbergianum* var. *meridionale* is admired for the pale pink flowers. It is claimed to be the tallest of all the pachypodiums.



*Pachypodium rutenbergianum* flowering in Miami during December

The tallest of the African species, *P. lealii*, is very variable in appearance. It develops a large above ground caudex which can be low and wide or taller and more tapering. This is most evident in one of the two subspecies (*P. lealii* ssp *saundersii*) found in a restricted area on the east coast of southern Africa. By contrast *P. lealii* ssp. *lealii*, which occurs in an even more

restricted are on the west coast is not as squat, but far more upright to 18' with a conical to bottle shaped grey trunk. Both produce small white flowers, which in ssp. *saundersii* are unusual in being self fertile. Of the two, ssp *saundersii* is most readily available and easiest to grow, coming from a less arid habitat than ssp. *lealii*.



*Pachypodium lamerei* in winter

Of the remaining African species, *P. namaquanum* is the tallest with a 6' spiny, tapering stem, swollen at the base whilst at apex there is a terminal rosette of leaves. In cultivation this is a most striking plant. However unlike other pachypodiums from Africa it has not adjusted to northern hemisphere seasons, becoming dormant at the beginning of summer (Miami's wet season). At this time it is at increased risk of rotting. Growth resumes by late summer and continues throughout winter when the plant needs to be kept watered.

Apart from *P. lealii* ssp *saundersii* there are several other pachypodiums that develop low squat trunks. The three Madagascan species, *P. rosulatum*, *P. densiflorum* and *P. horombense* are all very similar with showy yellow flowers and a trunk often as wide as it is tall. The mature plants develop a crown of short, thick, forked branches, branching occurring after flowering. There are varietal

differences recognized within each of the following species: *P. densiflorum* (two) and *P. rosulatum* (four). Differentiating within and between species is based on flower structure.

In contrast to those species with a visible caudex, both *P. succulentum* and *P. bispinosum* develop huge underground, often branching caudices. In the wild these can grow to a width of more than 2', and support several thin, fleshy stems. Each stem is usually no more than 2 – 3', with most leaves crowded at the stem tips. Leaves are, narrow, lance shaped to about 2", and coupled with a pair of 1" stiff spines. The two above species differ most in their flowers. Both species have flowers with white lobes and a pink to purple corolla tube. Those of *P. bispinosum* are more bell-shaped, with a wider corolla tube.



*Pachypodium baronii* var. *baronii*

There is only one pachypodium species that produces red flowers. This is *P. baronii* of which two varieties have been found wild in Madagascar. Of the two, var. *baronii* is the larger (to 6' in native habitat) with a broad flask shaped trunk, spiny branches and beautiful, large shiny leaves. Bright red salver form flowers appear on long stalks during summer. The var. *windsorii* is smaller and has red flowers with a white eye in smaller clusters on much shorter

stems. The former species is found on limestone, the latter on more acid granite. Whether this reflects some actual cultural need regarding soil pH is not known.

Two further Madagascan pachypodiums are worthy of mention. The first, *P. brevicaule* is notable as the most diminutive of all, being no more than several inches high. It develops a large, flat, irregularly shaped, knobby caudex. A number of short spiny stems with small terminally placed leaves are found which bear small clusters of bright yellow flowers.

This is a slow growing plant, susceptible to rotting, and is easier to grow if grafted onto *P. lamerei*.

Finally *P. decaryi* is unique in being almost devoid of spines, and of all species most closely resembles *Adenium*. Like *P. baronii* it forms a large caudex from which one or more smooth stems grow to no more than 4-6'. The flowers are strongly scented and the largest in the genus, white to 4" wide with broad asymmetric petals.

***Pedilanthus*** (Euphorbiaceae). A small genus of succulent shrubs from tropical areas of the Americas, one species in particular (*P. tithymaloides*) being grown for its' unusual form and colorful inflorescence. The plant grows to about 9', with thick, keeled, ovate leaves. The inflorescence consists of small insignificant greenish flowers (cyathia) borne in terminal clusters, each surrounded by a two lipped red bract that resembles a small slipper. In the ssp. *smallii*, the direction of growth of the stem changes to produce a zig zag effect. This is the form most familiar in landscapes, and is known commonly as the zigzag plant or devil's backbone. The cultivar '**Variegatus**' has leaves variegated green, white and pinkish red.

Two other species are occasionally grown. *Pedilanthus macrocarpus* is a shrubby plant to about 5' with smooth green succulent stems often covered with a waxy white bloom, insignificant leaves and red tubular flowers (flower bracts). *Pedilanthus bracteatus* forms a larger evergreen shrub growing up to 10' with 6" leaves that are glabrous or covered with microscopic hairs.

Plant all these species in full sun and backfill with the modified scree mix, reducing the proportion of large aggregate and increasing the amount of coarse sand. Reduce watering during cool winter weather.

***Pereskia*** (Cactaceae) Although regarded as xerophytes, pereskias are not strictly succulent, but are included in this review since they are part of the Cactaceae. In contrast to other members of the Cactaceae, pereskias have woody stems, which in addition are leafy and none-segmented (unlike most cacti). However in common with cacti, they produce spines from areoles, specialized areas of stem tissue<sup>17</sup> The exact evolutionary relationship between pereskias and other cacti is not fully understood. Pereskias grow as woody shrubs/vines or small trees, some with tuberous roots, the leaves wide, flat and thin and usually deciduous. The flowers are bowl shaped, usually very showy, some bearing a superficial resemblance to a rose.

Pereskias can be planted in full sun with light afternoon shade – it is important that they receive full morning sun in order to flower. Use the modified scree

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<sup>17</sup> See p. 26 for further information.

mix, reducing the proportion of large aggregate and increasing the amount of coarse sand and grit, plus about 30-40% organic matter. In late spring and summer, water to keep the soil just moist during any prolonged hot dry weather. Withhold water during winter.

Most widely grown as an ornamental *P. grandifolia* (rose cactus) is an upright 6 – 15' evergreen shrub. The stems are thick and spiny, the leaves thin and narrow and clusters of 1-2" pink to purplish pink flowers appear late summer into fall.

Two other pereskias are also common in cultivation, *P. aculeata* (Barbados gooseberry) and *P. bleo* (orange rose-cactus), both scandent to climbing plants that require some degree of support, and plenty of room. The former is a vigorous climbing deciduous shrub to more than 20' requiring a large support, suited only to a large rock garden. The plant assumes a somewhat more compact form if grown in

full sun, and the more bushy variety *Godseffiana* is selected. In late summer it produces open 2" flowers with creamy petals and a prominent disc of orangey apricot stamens. These are followed by edible acidic 1" round to pear shaped fruit with many seeds. There are old records of *P. aculeata* growing wild in SW Miami-Dade.

The other pereskia, *P. bleo* makes a more rambling plant that loses some foliage in winter depending on how cold it becomes. In spring showy, orangey red, open rose like flowers appear. Both of these pereskias have been reported growing wild in several counties of central Florida.

**Portulacaria** (Portulacariaceae) *Portulacaria* is usually regarded as a genus containing a single species, *P. afra* (elephant bush). This is a small slow growing succulent shrub/tree (about 9') native to dry rocky areas of eastern South Africa. At first glance it can be mistaken for *Crassula ovata* (jade plant), however the fleshy, round 3/4" leaves are smaller, the growth habit more angular with the stems segmented at each node. The reddish brown stems contrast well with the glossy green leaves<sup>18</sup>. In the wild during spring *P. afra* is covered with numerous small, pink flowers - these are rarely seen in cultivated plants.

The elephant bush can take limited afternoon shade, but is best in full sun. When planting in a dry rock garden use as backfill a mix of 75% gravel and coarse sand with the remaining 25% one or more of the following: well rotted compost, compost based potting soil and Canadian peat. Watering is required only during prolonged periods of hot dry weather, with none at all through winter. In late spring apply a slow release fertilizer. Prune lightly as needed to shape.

**Stapelia** (Apocynaceae). Although superficially resembling cacti (or one of the smaller succulent euphorbias) stapelias lack spines and do not contain latex. They are commonly referred to as carrion flowers because the unusually ornate, sometimes fetid flowers attract blowflies as pollinators. These are low growing (12" or less), clump forming plants, which branch at the base to form ridged (4-

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<sup>18</sup> There are several forms with variegated foliage: 'Tricolor' has leaves edged cream with a pinkish margin, reddish stems and a more lax habit; var. *folis-variegatus* has green/yellow mottled leaves and var. *macrophylla* larger leaves. The cv. *Medio-picta* is slower growing with a distinct yellow streak down the middle of each leaf.

6 angled), thick succulent stems. Each ridge bears a series of blunt teeth and small rudimentary leaves (plants are essentially leafless).

The principal reason for growing stapeliads is their large often bizarrely patterned leathery flowers. These form at the base to the middle of each stem on a long stalk, most ranging from 2 to 8" in diameter. The corolla is deeply lobed (five petals), usually flat like a starfish with the lobes often reflexed, or rarely more cup shaped. The flowers, often covered with a mat of silky hairs, can be yellow, brown, red or purple, with darker mottling, spots or stripes. To varying degrees most have a putrid smell, though outdoors at a distance this is not noticeable. Flowering occurs during the warm months of the year especially late summer into fall. One feature common to the flowers of these and all other former asclepiids is a prominent corona. This is a ring of petal like appendages within the corolla that resemble a crown.

In a dry rock garden allow room for clumps to spread where they can be used as a ground cover. Place at a distance such that any flies attracted to the flowers will not be a nuisance. Select an area with some partial shade from intense afternoon sun (lea of a large boulder or a neighboring plant). Use the modified scree mix as backfill, and apply gravel mulch. It is important with the more prostrate spreading stapeliads to spread inorganic mulch under the stems to keep the stem bases from contacting any soil. Water only during periods of prolonged hot dry weather (every 7 – 10 days); during winter as temperatures fall below 75°F withhold water altogether. Provide a light application of a slow release fertilizer during late spring. Apart from stem rots, mealybugs and scale insects are potential pests.

Stapelias and related plants (see below) are popular items for specialist collectors as container plants. Not as easy to find as the more widely grown succulents such as agaves, aloes and some of the caudiciforms, most succulent growers offer at least one or two species. To propagate take 2 – 3" stem cuttings during late winter, dipping the cut end in charcoal, shaking off any excess, and allowing it to dry out for 5 – 7 days. After drying, the end of each cutting can then be dusted with rooting hormone/fungicide before inserting it to a depth of no more than ¼" into a barely moist mix of Perlite and fine grit plus 10% Canadian peat. Cuttings should be periodically misted until rooted (within 3 – 5 weeks).

Frequently seen in cultivation for the enormous flowers, *S. gigantea* produces large solitary star shaped flowers (to 14" diameter), pale ochre to yellow, the surface covered with many small reddish wrinkles, the red intensifying toward the corona.. The cultivar 'Schwankart' has odorless flowers. *Stapelia grandiflora*, despite its' name, has smaller flowers than *S. gigantea*. Each flower is up to 6" in diameter, flattened, star-shaped (spreading triangular lobes), reddish purple, darkening toward

the corona, lobes narrowly banded yellow and densely covered with purplish hairs.

Commonly known as Zulu giant, *S. leendertziae* is unusual in having bell-shaped flowers (petals partially fused) with shorter pointed lobes. Each flower is up to 4" in diameter, deep purple, with the inner surface rugose. There is a form with crested stems (cristate), but this does not seem to flower. *Stapelia flavo-purpurea* like *S. gigantea* 'Schwankart' does not have malodorous flowers – at least one authority

describes them as honey scented. This is a small *Stapelia*: stems no more than 2½", flowers flat, 1½" across, the corolla tube short and white, covered with red hairs; deeply lobed each lobe yellow, linear (slender) covered with prominent irregular wrinkles.



*Stapelia* spp. in Miami landscape

In contrast *S. kwebensis* has small chocolate brown flowers, hairless but with many small wrinkles and an intensely putrid odor. *Stapelia hirsuta* has 4-5" densely hairy flowers, the lobes reddish yellow to maroon with thin transverse yellow to red stripes, the corona a deep purple. *Stapelia schinzii* has short bright green stems lightly mottled purple. The star shaped flowers are large (up to 9"), hairy, dark brown with many small transverse red to purple wrinkles. *Stapelia asterias* var. *lucida* forms dense clumps, individual stems pubescent, pale green with inconspicuous teeth, and growing to about 8". The center of each 5" flower is a deep purplish red, very glossy, the color less intense out from the center. The lobes are lanceolate to linear, the surface rugose with hairy margins.

There are other related plants within the Apocynaceae that like stapelias have ornate, usually large, attractive, but unpleasant smelling flowers that attract flies as pollinators. Many were formerly classified as stapelias, but have now been moved to several separate genera. There are too many to mention, and most are grown by enthusiasts in containers. Some are low growing spreading plants that could have potential as limited ground covers for a dry rock garden; however their survival under south Florida conditions is uncertain. In some instances, (e.g., some of the *Caramulla*) since the risk of rotting is high, cuttings are grafted on to a *Stapelia* or *Ceropegia*. The following is a selection of some of the better known species.

**Orbea.** Closely related to stapelias, orbeas have similar cultivation requirements. The principal difference between the two is the appearance of the flowers, orbeas having an annulus (raised thickened area) surrounding the corona. *Orbea variegata* (toad cactus), still sometimes referred to under its old name *Stapelia variegata*, is one of the easiest of all carrion flowers to grow. It forms erect low-growing clumps to about 4" high, having angular grey/green stems with prominent sharp teeth. The stems can be mottled reddish purple particularly if grown in full sun. This species is very variable, particularly the appearance of the flowers, and in the past were ascribed to true varietal differences. From 1 - 5 flowers are found in open cymes, each 2 -4" across, flat and star shaped with broad lobes. The flowers are greenish yellow to pale yellow with reddish brown blotches; the interior densely wrinkled with a prominent corona. The stench of the flowers varies, though at least one writer claims it is more intense if they are grown in full sun. *Orbea speciosa* has



smaller flowers of similar shape, though the lobes are slightly recurved. Flowers are yellow with red to maroon blotches, especially toward the tips of the lobes, the margins of which have dense red hairs.

**Huernia** (dragon flowers). These are found growing in the same semi arid areas of southern and east Africa that favor stapelias. They are low growing, usually clump forming and shallow rooted. The stems are short, smooth, 4-7 angled, grayish green with prominent soft teeth, often developing purplish red blotches. The flowers are sessile or on short stalks, wheel to bell shaped the lobes fleshy, frequently with prominent spots and/or stripes, with little or no fragrance. Grow in full sun, providing some light shade from hot afternoon

summer sun.



**Huernia** spp. (unidentified cross) in flower

**Huernia hislopii** has 5 – 7 angled, basally branching 2” stems with short strong teeth. Flowers are solitary, about 1” across with a deep red center, the lobes triangular-attenuate, cream colored with numerous blood red spots. **Huernia hystrix** has larger (4 – 6”), purple tinged light green stems, 5 angled with prominent teeth, The flowers occur at the stem base, no more than 1½” in diameter, having a short broad corolla tube, cream to brownish yellow triangular lobes with crimson spots. The surface is covered with numerous short fleshy protuberances (papillae).

The Kenyan dragon flower (**H. keniensis**) has somewhat less angular, stouter stems. Flowers to 1½” diameter: raspberry red lobes, darker more purplish red toward the center where the surface is covered with rough fleshy protuberances. The **var. grandiflora** has

flowers to 2” diameter and off white lobes with a dark purple center. Owl’s eyes (**H. zebrina**) has 2” flowers with pale yellow to greenish yellow lobes banded reddish brown, and a prominent fleshy yellow annulus with extensive reddish brown blotches. The **var. magniflora** has flowers up to 3” diameter with more intense coloring: the lobes are pale yellow with crimson bands, the annulus more prominent and chocolate brown. **Huernia levyi** has 3” stems with prominent teeth, and is somewhat unusual in having tubular flowers. They are cream to yellow with maroon spots, a darker maroon base, and spreading attenuate lobes.

**Stapelianthus** These are closely related to *Huernia*, but their distribution is restricted to the more arid areas of southern Madagascar. Most are low-growing and clump-forming, having prostrate to ascending, 4-8 angled short stems covered with spirally arranged tubercles (small warty protuberances). Small leaves are quickly lost from new stems. Flowers are flat to bell shaped,

lobed with a distinct tube. *Stapelianthus hardyi* forms a mat of short, pale, grayish green stems with scattered ½” bell shaped purplish red to reddish brown flowers, the lobes densely covered with soft dark purple hairs. Since it is less decumbent and more erect, *S. keraudrenae* may be less prone to rot. One of the larger members of the genus, growing to at least 12”, with pale green stems having darker green and purple blotches. There are from 2-4 basal flowers per stem, each 1½” across: the lobes are triangular, yellow with purplish red spots and fringed edge, in addition there is a prominent, raised, reddish brown, fleshy annulus and distinct dark purple corona.

**Hoodia** Found in arid rocky areas of southern Africa growing in full sun, these are larger more robust plants than stapelias, some species growing up to 3’. The stems are leafless, grey green and multi-angled, covered with numerous small tubercles and hardened thorn like teeth. Unlike stapelias and above related plants, flowers are borne toward the apex of the stem and are disc to cup shaped, rather than star shaped, with greatly reduced lobes. Interest in hoodias has grown following widespread media coverage describing their use as an appetite suppressant (*H. gordonii*). For this reason they can be difficult to find, and are usually far more expensive than other stapeliads. *Hoodia* are more liable to rot than the any of the above stapeliads, and for this reason more difficult to grow outdoors in Miami-Dade. Before attempting to grow them in a dry rock garden it would be prudent to propagate additional plants so that you do not risk a rare/expensive specimen. Given sufficient heat they readily root from cuttings in a barely moist potting mix (see above) with occasional brief misting. They must be grown in full sun, a fact that has hindered indoor cultivation.

**Synadenium** (Euphorbiaceae) A genus of succulent shrubs found mostly in eastern and southern Africa. They are grown mainly for their attractive foliage: thick fleshy leaves, ovate to lance shaped, shiny, bright green, wine red to purple or variegated. Panicles or umbels of small flowers (yellow to red) appear sporadically throughout the year. Use as a specimen or accent plant in a large dry rock garden. Species in cultivation range in size from 6 -20’ having fleshy stems containing large amounts of white latex – thus the common name African milkbush. The latex is very poisonous both externally, causing severe skin irritation, and internally (*cf.* succulent euphorbias). For this reason exercise caution when installing synadeniums; they are best planted away from foot traffic.

Select a part of the garden in full sun, using the modified scree mix containing 25% organic material as backfill. During late winter carefully prune to shape if necessary, and in spring provide a light application of a balanced slow release fertilizer. Do not water during winter; at other times only during prolonged periods of hot dry weather. Synadeniums are easy to grow from cuttings, best taken during late winter: the cut end should be allowed to dry before placing it in potting mix.

Most frequently seen in landscapes is *S. compactum* var. *rubrum* growing to 20', the leaves lance to oval shaped, red with the undersides a reddish purple. Another less common form, var. *compactum* has bright green leaves streaked purple. There is confusion as to naming between *S. compactum* and the smaller shrubbier *S. grantii* – plants with purple/red foliage are sometimes offered as *S. grantii* 'Rubra'. Far rarer in landscapes is the smaller *S. cupulare* from South Africa where it is known as the 'Sheba valley death tree'. This species grows to only 4 – 5' and branches from the base, producing smooth green, succulent branches which become woody with age. The obovate leaves are also smaller, 4 x 1½" (half the size of the above synadeniums). Locally in South Africa it was believed that *S. cupulare* is so deadly that a bird flying over the tree would drop down lifeless! A graphic exaggeration, but no doubt it served to dramatize the poisonous nature of this plant.

**Talinum** (Portulacaceae) Related to purslane, *Talinum* ssp. are found in dry grass/scrub land in tropical and subtropical regions of Africa as well as North and Central America. From a swollen or fleshy rootstock arise soft succulent stems (the basal portion of which usually becomes woody) that bear rosettes of thick fleshy leaves. Flowers form at the stem apex in erect panicles or cymes, each flower usually with five petals and prominent yellow stamens. Individual flowers are short-lived, but flowering is usually over an extended period. Plants should be set out in full sun using a scree mix with less large aggregate and additional coarse sand or poultry grit with 25% organic material. Provide water during extended periods of hot dry weather, with only occasional watering during winter.

The variegated form of *T. paniculatum* (jewels of Opar) has become fairly common in Miami-Dade landscapes, where it will succeed in full sun areas having free draining soil. The foliage is variegated light green and white with a pinkish tinge, the inflorescence made up of many small cup shaped red or yellow flowers. The variegated form, unlike the true species, is not prone to become invasive.

Less familiar is *T. caffrum* from southern Africa, which grows from a thickened caudex-like rootstock, producing spreading to almost erect stems bearing thick fleshy, lanceolate to oval leaves. Solitary pale yellow flowers open during the day throughout the summer. Formerly known as *Talinum guadalupense* this small compact succulent shrub from Mexico has been reclassified as *Cistanthe guadalupense* another genus within the Portulacaceae. The stems are thickened and swollen with rosettes of fleshy blue-green 2" spoon-shaped leaves at the tips. Pink flowers are borne in panicles throughout the summer.

**Uncarina** (Pedaliaceae). This genus of plants in the sesame family is found growing in arid areas of Madagascar, particularly in limestone outcrops. Originally of interest as container plants for collectors of succulents/'fat plants', they are being used more as landscape items in frost free areas. In outdoor cultivation uncarinas grow as much-branched shrubs or small trees (all under 10'). They develop swollen stems (some also develop a pronounced caudex) with coarse textured foliage, the leaves often lobed, and covered with soft hairs. Of special note is the profusion of showy flowers, in various shades of yellow as

well as pink, red or white. Many will commence flowering as 5-6" container plants.

Because of the intricate mechanism of insect mediated pollination, the availability of seed grown trees is limited. Hand pollination is possible but difficult. Only one species in cultivation, *U. roesoeliana*, is known to readily set seed (at least in California). Uncarinas form a seed capsule bearing many long, stiff spines each tipped with a sharp curved point, which in the wild becomes enmeshed in animal fur (especially lemurs). This acts as a means of seed dispersal, seed only being released once the capsule disintegrates. *Uncarina* seed capsules are notoriously difficult and painful to remove from clothing. Plants grown from cuttings are more often offered for sale, but may not develop a prominent caudex. In other respects they are similar and flower freely.

Uncarinas should prove to be among the more easily grown succulents for a Miami-Dade dry rock garden. They are well adapted to limestone as well as hot, wet summers and warm dry winters. Small plants are susceptible to cold damage as temperatures drop to the low 40's, but larger established plants can withstand lower temperatures including brief exposure to a light frost. Cold damaged stems should be removed to prevent rotting, which could then spread to undamaged parts of the plant. Leaf damage from serpentine leaf miners has been noticed locally, but this is mainly a cosmetic problem. Small plants are best kept in a container for the first year until large enough to plant outdoors when exposure to low temperatures will be far less injurious. Uncarinas are fast growing if provided with sufficient water (during the summer), heat, and fertilizer. They should be situated in direct sun, and planted in basic scree mix with less large aggregate and more sharp sand/poultry grit, plus some crushed Miami limestone and 20 - 25% organic matter.

Flowering *Uncarina grandidieri* in Miami-Dade landscape

During hot dry weather water weekly and for container plants use half strength liquid fertilizer every month. In a dry rock garden an *Uncarina* will respond to an application of a slow release fertilizer in May and again in August. Reduce watering during



winter, ceasing altogether as temperatures fall below 75°F. Uncarinas are available from a number of mail order nurseries that grow succulents.



*Uncarina grandideri* cutting flowering within a year.

The most widely available species, *U. roesoeliana*, has pale yellow flowers with a tubular corolla and five large spreading lobes. The leaves are on long petioles and at least two types of lobing are found depending on the plant type: either deeply lobed and dark green or paler green and more heart-shaped (cordate). *Uncarina grandideri* has golden yellow flowers with a maroon corolla tube and slightly lobed cordate leaves. The following species are not offered for sale as often: *U. peltata* lemon yellow flowers with a red to maroon throat; *U. perrieri* has orangey yellow flowers, *U. decaryi* has yellow flowers and parted leaves with three finger like lobes; *U. leptocarpa* has white flowers, the corolla tube pale yellow; *U. abbreviata* pale pink flowers and *U. stellulifera* pale pinkish purple flowers and grayish green leaves.

**Yucca** (Agavaceae). Yuccas like the related agaves are not unfamiliar in Miami - Dade landscapes. They can be planted without need for a dry rock garden, providing the site chosen has free draining soil (plenty of coarse sand or similar size aggregate) and preferably a full sun exposure. As with agaves there is need to exercise caution in placing yuccas in the landscape since most have stiff leaves, each with long narrow tips that come to a razor sharp point (referred to as pungent). The leaves occur in spirally arranged rosettes at the stem apex. They are thinner, more fibrous (never succulent) with smooth margins compared to most agaves. Though there are a few acaulescent yuccas, most develop a far more sturdy and prominent stem than an agave, up to 30' for some species in the wild. Unlike agaves which only flower once then die, all but one species of yucca (*Y. whipplei*) are polycarpic. The Yucca inflorescence is a spike like panicle composed of round to bell shaped, often pendent, rather fleshy white flowers that may be tinged purple. The inflorescence is borne on a sturdy scape that emerges from the axils of the upper leaf rosettes. The flowers are nocturnal, being pollinated by night flying moths.

One of the most popular species is the spineless yucca *Y. guatemalensis* which can grow to more than 25', and makes an impressive specimen plant for a large dry rock garden. An important advantage of this yucca, as the name suggests, is the fact that it is unarmed. The stiff, 4' strap-like leaves have margins with minute teeth, and are arranged in rosettes atop a sturdy stem. With age the stem develops the appearance of a tree trunk with a rough surface and swollen base (up to 4'). Suckers form at the base of the plant and can be removed for propagation. The cv. Variegata has leaves with cream colored margins.

Also most as effective as a specimen plant is the beaked yucca, *Y. thompsoniana* (syn. *Y. rostrata*). This is smaller than the spineless yucca, eventually growing to 15', forming a trunk like stem covered in the remnants of old leaves. New foliage radiates from the stem apex consisting of many long thin, flexible grey-green leaves. The leaves are up to 3½', spiny-pungent, with a yellow to brown margin.

The banana yucca (*Y. baccata*) is a low growing clumping yucca, with at most a short (2-3') prostrate stem. It produces a rosette of 3-4' sword shaped deep green leaves tinged blue, pungent with filiferous

margins (attached filaments). The inflorescence develops in spring and consists of a spike of showy, white, bell shaped flowers borne on a 2-3' stem. These are followed by 6-7" banana shaped fruit which are sweet and edible. Allow space in the landscape for the production of numerous offsets.

Another low growing yucca is the virtually acaulescent *Y. rupicola*, the twisted leaf yucca, that is especially well adapted to

limestone. The leaves are light green, twisted, with yellow margins turning red, acuminate, tipped with a brown spine. The 3" pendent white flowers are borne on a stem 4 to 5' above the leaf rosette. An ideal yucca where space is limited individual plants growing to a width of no more than 2'. Although the twisted leaf yucca will produce offsets, it is not quite as prolific as the banana yucca.



If you still have open areas in your dry rock garden fill in with a drought tolerant groundcover such as this colorful purslane (*Portulaca oleracea*).

### Closing Remarks

If you are interested in installing a dry rock garden, it would be well worth the effort to first visit some of the fine local display gardens, such as Fairchild Tropical Garden and Pinecrest Gardens. Both have dry rock garden/arid land installations that feature a range of succulents including many described in this publication. You will be able to see what many of these plants look like under Miami-Dade conditions. Finally when you believe that you are ready to proceed make certain by checking the following items:

† Can I devote the time needed to maintain a dry rock garden, especially keeping it free of weeds and plant litter? During a typical Miami-Dade summer weeds can rapidly grow and take over your installation if weeding is neglected.

† Do I have a suitable space in full sun and of sufficient area to install a dry rock garden?

† Do I have a set of plans showing what succulents I have chosen and where they will be situated within the dry rock garden? Have I allowed space for future growth of the succulents chosen?

† Have I sources from which to obtain the supplies required to build the rock garden? Some items such as coarse sand and poultry grit can be difficult to locate.

† Are there local growers who can supply the succulents that I intend to purchase? When planting succulents it is more than likely that for at least some of your plants you will need to use a mail order nursery. You need to be absolutely clear about their shipping policies – bare root or container plants, time of the year they do not ship, returns/refunds.

† Are you prepared for some trial and error? There is limited local experience with dry rock gardens. Carefully consider your choices when growing succulents that are new to you (do a little research first), then by all means experiment.

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## **Further Reading**

Anderson, M. 2003 *The Complete Guide to Growing Cacti and Succulents*. Lorenz Books, London U.K. 256p.

Brickell, B. and H. M. Cathey, eds. 2004 *The American Horticultural Society A-Z Encyclopedia of Garden Plants*, DK Publishing, New York, N.Y. 1009p.

Cave, Y. 2003 *Succulents for the Contemporary Garden*. Timber Press, Portland, OR. 176p.

de Vosjoli, P. 2004 *A Guide to Growing Pachycaul and Caudiciform Plants*. Advanced Visions, Inc. Vista, California. 319p.

Hewitt, T. 1993 *The Complete Book of Cacti and Succulents* DK Publishing, New York, N.Y. 176p.

Huxley, A. M. and M. Levy, eds. 1999 *The New Royal Horticultural Society Dictionary of Gardening, Vols. 1-4*. Groves Dictionaries, Inc., New York, N.Y.

Rowley, G. 1999 *The Cactus File Handbook 5: Pachypodium and Adenium*. Cirio Publishing Services, Southampton, U.K. 80p.

Sajeva, M. and Costanzo, M. 2000 *Suculents II The New Illustrated Dictionary*. Timber Press, Portland OR. 234p.

Apart from the books/monographs listed above there are a number of periodicals including the **Cactus and Succulent Journal**, published by the **Cactus and Succulent Society of America**, and **The Amateurs' Digest**, devoted to cacti, succulents and caudiciform plants. Many web sites are available on the internet that provide both information and photographs of a wide range of succulent plants. One excellent and comprehensive departure point is the Cactus and Succulent Plant Mall: <http://www.cactus-mall.com/>