The Soil Hexalogue

INTRODUCTION

Finally, I have decided to publish my conclusions following years of experiments, approaching the whole matter – how to prepare a potting mix for cacti – from a fresh perspective, in order to provide serviceable information for all who wish to grow their plants in a ”natural” substrate prepared by themselves.

In time I have found out two things:

1. *that every advanced cactus grower has his own substrate recipe which is – he always believes so – the best and the only acceptable* – this proves without any doubt the inconsistency of the statement; and

2. *every time I had to mix another batch of soil, this was by far much better than the preceding batch* – this proves how relatival any approach on this subject can be.

All these years, as time passed by, people increasingly started to prepare their soil mix after ”my method”, and in a similar way I have started to prepare my soil mixes using someone else’s ”method”...

Every time I was advising or responding to someone’s questions, every time I was posting messages on forums or websites – from here and from everywhere - I knew (every time!) that I couldn’t provide a thorough answer to a very punctual question, and therefore that I couldn’t be really useful purely because I was not able to ideate correctly – and as a matter of fact I used to be rather abnormally fuzzy and indefinite in my feedbacks, for the astonishment of all those expecting precise information and concrete facts.

And if one is not being able to define precisely the things he is trying to explain, this simply means that he does not really know what he is talking about – in other words I realised that I have first to understand for myself why I prepare my soil mixes this way and not in some other random manner, and secondly if I was doing it right.

This has forced me to seek and seek until I knew I’ve got all the right answers, and as a result I was now being able to concentrate everything I knew in pre-requisites, definitions and the six general and essential rules: **The Soil Hexalogue**.

But first of all – I have learned that I needed to forget everything I knew about this subject and that I had to start from the scratch!

This happened only when I realised that I have entered the world of the rock-eaters:

Mammillaria tetrancistra

The Six Rules

Motto: **"The more northern the origin of the species, the less organic components the soil should contain." - *Coryphantha* by R. Dicht & A. Luthy**

PRE-REQUISITE No. 1

It is understood that plants are watered using rain water or de-mineralised water only; otherwise the carbonates and sulphates in the tap water will alter – by accumulation – the pH of the soil mix.

NOTE the pH* and the water-hardness ** are two totally different concepts!

ATTENTION! The accumulation of salts in the soil mix that occurs because of very hard and/or very mineralised water used will change the pH in the soil depending on the accumulated salts! ➔ no matter the type of the soil mix it will become useless! Such unwanted water types are: tap water, spring water, or well water ➔ generally having over 5-6 dGH (see below); except for the tap water the water-hardness can climb quite frequently over 20-25 dGH.

PRE-REQUISITE No. 2

It is not the same thing to grow a cactus in a pot or to let it grow in a natural environment! **Potted plants are not only captives, but their soil is captive too and therefore you can't compare the reactions occurring in pots with the reactions occurring in "free" natural soils.**

NOTE By *natural environment* I understand natural habitats… or at least permanent outdoors planting where free root-run is given.

1st DEFINITION

In the acceptance of this article the mix of mineral materials of natural origin or obtained by simply processing these - suitable for plants cultivation – which excludes any materials resulting from vegetal or animal decomposition, is referred here as mineral soil, mineral mix or mineral soil mix.

NOTE A soil mix containing even 5% materials of vegetal decomposition is not a mineral soil (see the note to the 2nd definition)! The wording "100% mineral soil" is a pleonasm.

REMARK In all pedological papers the above definition is fully obliterated by their own concepts; however, pedologists are not concerned about potting mix…

2nd DEFINITION

In the acceptance of this article the mix of materials resulting from vegetal decomposition and mineral materials is referred as being an organic soil or organic mix.

NOTE A mixture contaning more than 60% mineral materials is referred here as mineralised mix, soil or earth – but in accordance with the 1st definition it is an organic soil too! (see the note to the 1st definition)

There is a common rhetorical question – why do we have problems with the potting mix for our cacti???

The answer is easy but hard to perceive at first glance: simply because cacti are different!

We usually are confused simply because we do not understand who has delivered us all we have learned about cacti. For us, the common cacti growers, the information was delivered by "*scientists*". In fact, things are quite different: Botanists and Ecologists were not particularly interested in growing cacti and other succulents, but more inclined to study plants in their habitats; therefore they wrote botanical papers and monographs about cacti, not cultivation textbooks.

On the other hand "*professional gardeners*" who originally collected these plants and introduced them to glasshouse cultivation – initially as oddities and later as a potential source of profit for their trade – have cultivated them right from the start as any other mass product and continue so to this day; they wrote even books on cacti cultivation sharing advices emanating from their own experience and presenting them as indisputable, generally valid facts.

Not only that these are not indisputable, generally valid facts, but – more in essence than in form – most of the things we have learned are not even true!

Of course, we are not speaking here of dishonesty, but only of the fact that the "*professional gardeners*" – being practical people and not theorists – were not aware and have not acknowledged two things:

1. the plants they deal with; the cultivation of xerophytes – as practised in European and North American nurseries – was defined in its main co-ordinates well before metabolic studies have revealed the existing specialisation in these plants; for the "*professional gardeners*" of the 19th century succulent plants and especially cacti were regarded only as exotic plants in need to be adapted to the existing cultivation environment, and propagated for a quick sale. Simple as that!

2. it's not all the same when you grow these plants in Germany, Italy, Romania or Canada ➔ you can't even adjust your local cultivation parameters based on information like "this is how it should be grown in Canada" or in "Europe" due to its vagueness.

This perspective and the adjacent cultivation practices have been perpetuated and transferred literally from a grower to another, from father to son, from generation to generation, from master to apprentice for two centuries.

That's how they knew it would work well for them, that's how they have mass produced plants and made profits; in the end there was no incentive to change something or look beyond the pot margins even if their plants looked more like water melons or cucumbers, green, very green, and well fed, totally different from the fascinating specimens out in the wild.

Nowadays, even if growing cacti has become a global hobby, we have to live with the paradox that the cultivation advices we read in different books do not vary in their essence! All books present in essence more or less the same old cultivation advices we have learned from the early "*professional gardeners*"… with small formal variations on the same theme!

We – the hobbyists – have been taught to see in xerophytes nothing else but ordinary plants, and to observe the cultivation needs of ordinary plants – rich soils, fertilizers, and generous watering. We constantly forget in dealing with our plants about the harsh environment the cacti live in, even if we have an ideea or even if we feel attracted by their peculiar habitats.

We always forget that cacti are the inhabitants of extreme environments and that they have a different metabolism (CAM) than most of the plants surrounding us. And even if we acknowledge that their gase-exchange works at night and not during the day as in normal plants, this doesn't mean too much to us; we still pay tribute to a general "*knowledge*" about our plants almost hard-

wired in our minds… that's what we have learned since early childhood from our parents and grand parents, or from our primary school teachers – rich soils, plenty of fertilizers, generous watering and the wish to see them growing fast as… **It takes a deal to go over it!**

How to water cacti – that's the first thing we learn, some of us easier, some of us the hard way. That's what always experimented growers tell the greenhorns… basically the only thing they're repeatedly told. The "connoisseur" is always reassuring: cacti almost don't need water! By constantly, obsessively hearing this rogation some of us have started to kill our plants because we simply believed that cacti can thrive without water! But in the end we always manage somehow to get a feeling on how things should be.

But sadly that rich organic soil and plenty of fertilizers can nothing but please our plants (cacti or not) – like they please wheat, and corn, and beet, and soy (genetic modified or not) – looks rather obvious to us. More, we're always told to use specialised fertilizers, dedicated fertilizers, different fertilizers, new fertilisers, revolutionary fertilizers… (just have a look on the shelves in the garden centers). Credulous and naïve we do so without thinking twice… without understanding that not the fertiliser brand or type does really makes the difference, but that the practice of fertilising our cacti does the damage. One of the questions we never raise is why on earth even if cacti come from extremely varied habitats there is only one fertiliser "*for cacti*" with a single set of instructions on the shelves? Now, that's really strange as in current agricultural practices dosage and fertilising patterns may vary from hybrid to hybrid in a very discriminatory way?

From most books about cacti cultivation as from most nursery men as well we have learned that the typical potting mix for cacti is a mixture of something like 33% coarse sand, 33% well composted leaf mold, and 33% loamy earth – of course with non-essential variations depending on the grower, author, or country – but all pointing to an aged but undisputed principle – the 3/3/3 scheme.

The same sources tell us that some species – mostly rare or difficult cacti – have to be planted in a well mineralised potting mix (see notes to 1st and 2nd definition), but no-one is going into too many details on specific percentages or compounds (most authors like it lukewarm and safe).

Echinocactus polycephalus

My real contribution to this matter – after many many years of experimentation and gathered experience – is the discovery of the fact that all the pre-requisites of the "*professional gardeners*", which became in time the pre-requisites of the main stream growers, which were passed on to the newcomers and so on until becoming intangible cultivation pre-requisites, are essentially wrong.

Cacti are not rich earth dwellers like the romaine, but rock dwellers. Cacti do not feed on rich organic soil (as we humans do not feed on sugar), but feed mainly on minerals from the rocks!

By acknowledging this suddenly the whole picture changes: we are not forced to think anymore about what organic compounds and in what weight we need for our cacti, etc., but we have to ask ourselves which of our plants really needs organic soil mixes (and if there is any in need of it…).

I know, it is hard to understand and to get some grip, but I have started by stating that we need to forget everything we ever knew and start from scratch simply because nothing we know matches with the things we are looking for: to grow natural looking cacti.

RULE No. 1

Always start preparing a mineral mix to which organic compounds might be added (or not!); add organic compounds if and only if the cultivated plant really needs them – this is a case-by-case judgement.

DO NOT prepare an organic soil mixture only to mineralise it later depending on the species' needs.

Ferocactus cylindraceus

At first glance it looks to be the same thing, but it's not because the mineral compounds and the rocks from the soil – despite the popular belief – play an active role in nourishing the plant, their role being far from only breaking up the soil or taking care of the drainage.

They are vital compounds of the soils in which most cacti thrive in the wild.

Actually there are just very few cactus species needing anything else than mineral soil. Epiphytic cacti, few tall columnar species – but not all – and some of the preerie and forest species really need some organic compounds in their soil mix, covering everything from organic traces to outweighing all other compounds. All other cactus species – and this means the vast majority – live in mineral soils. Some thrive incredibly, while others – the more specialised ones – cannot survive on anything else but mineral soil.

Do not confuse a mineral mix with a well drained mix!!!

The confusion between mineral/mineralised soil and well drained soil has also started from the books, because the difference between the two was rarely well defined and explained. This is very strange as it is of crucial importance for the cultivation of *Cactaceae*, in such an extent that – with the same amount of water – you can either support vegetative outbursts or kill the poor plant if roots get waterlogged, much easier than cutting it into pieces. Stem segments can root, but dampness kills the roots and subsequently the plant.

As I wrote before, if the potting mix is mineral and completely excludes any compounds resulted from vegetal decomposition, this still does not mean it has a superb drainage – clay for example is a mineral compound, but it prevents drainage.

Mammillaria tetrancistra

A well drained mix allows water to easily flow through it. Such a mix can include organic compouds; it even can be purely organic. In other words: the drainage capability of the mix does not relate with the general type (mineral, organic, purely organic) but with the physical characteristics of its components any matter if organic or mineral.

RULE No. 2

No matter if mineral or organic – a mix needs to have the best possible drain.

Compounds like clay or structured soil (i.e. garden earth) affect the drainage capability of the mix in direct relation with their weight.

From the first two rules arises the third:

RULE No. 3

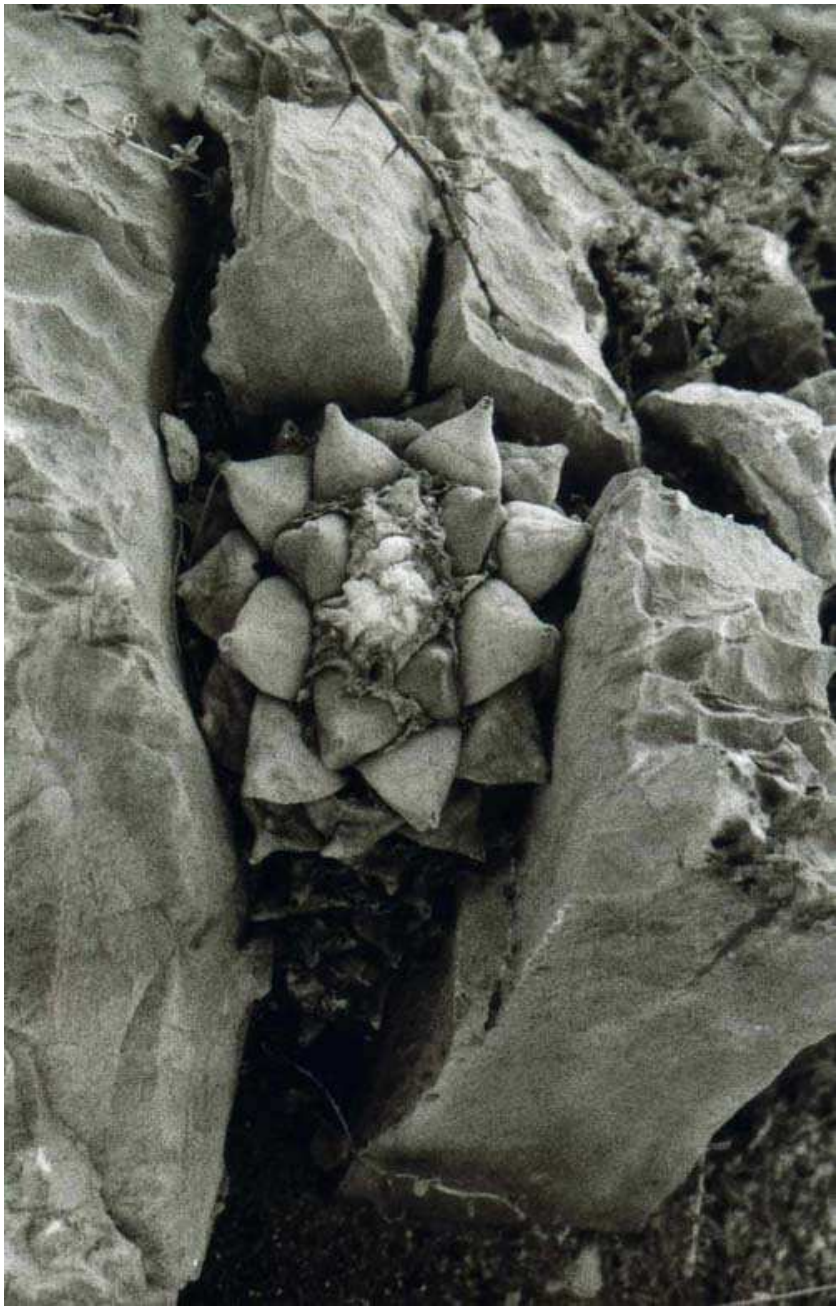
If you don't know the needs of your cactus, plant it in mineral well drained soil!

Of course all above mentioned exceptions have to be observed: epiphytic cacti and all other cacti living in forests or surrounded by lush vegetation (habitat pictures are extremely useful therefore).

Mammillaria candida

RULE No. 4

In order to be able to select the best possible mix type for a plant we need to be acquainted - at least from habitat pictures - with its habitat.



Ariocarpus retusus ssp. *retusus* - an exceptional plant, elongated in search of light, growing in a fissure between limestone rocks.

Of course there are plants with different degrees of tolerance to limestone, or plants which can adapt much easier than others, giving them a head-on in direct competition with other plants. The *Thelocactus* species are a very interesting example in this regard, by being encountered in the most varied habitat types, from very harsh to more settled ones.

The fact that some plants have adapted very well to alkaline pH does not mean that they don't accept – for short to medium periods of time – to grow in much richer soils with a rather acid pH, and they might even apparently enjoy this! The real problem is that these plants will soon show aberrant growths. The alkaline pH induced by limestone is a growth inhibitor for these plants; by lacking this inhibitor plants will grow to their potential, and not to their natural size. This aberrant growth – some plants look like being literally pumped up – contributes not only to the loss of their specific natural aspect, but especially makes them weaker when confronted with biotic and abiotic factors the plants are now unable to overcome. They become literally unrecognisable – lose their compact forms, the specific colours of the epidermis, their exceptional spination becomes weaker, etc. Sore epidermis heales much slower and becomes much easier infected or easy prey to fungi. An acari or insect attack is by far more damaging now, the epidermis being much thinner and the cells much "softer". A sudden drop in temperature becomes now a big deal as the plant's cells – even in resting plants – are now much more turgescent (swollen). While aerial parts tend to have a gigantesque development, the root system remains largely undeveloped and can't deal now with any water excess as it normally does. And we are far of having exhausted all possible examples.

Just very few cacti growers tend to observe that some of their plants need limestone. Most of them just talk down such a possibility!

Strombocactus disciformis ssp. *disciformis*

It is true that seen as living beings plant's metabolism does not need – in any form – limestone in the soil, plants having various ways of gathering all the calcium they need from various minerals. However, certain limestone content is highly recommended for calciphyte plants, so that plants don't have an "unnatural"aspect. Plants growing naturally in limestone dominated habitats are more or less natural bonsai. Deprived from limestone these plants return to what they "could have been" without it, far from what they really are, at least out in the wild. Sometimes they will show spectacular growth. However, due their genetic setup shaped by tens of thousands of generations they are accustomed with the constant struggle with the alkaline soils, this is the only "way of life" they have ever known. By releasing them from this struggle their growth will become too fast and therefore unhealthy, the plants becoming – I repeat this – prone to be put easily down by any disease or parasite.

A COME BACK

In order to keep the plants in good health on the long run, the grower is forced to inhibit the growth and development of calciphyte plants, by adding limestone in their mix.

NOTE As a rule of thumb – without being an absolute truth – South American cacti are calcifuge (do not tolerate alkaline limestone soils) while North American cacti are calciphyte (love alkaline limestone soils); there are several North American species growing on almost pure limestone in their habitat.

Ariocarpus scaphirostris (*scapharostrus*) - plants growing in limestone rubble

REMARK

A hypertrophyated plant is not a healthy plant and is not even good looking. A collection plant has to look as close as possibly to their relatives from the natural habitats.

All the above compels me to revisit Rule No. 3:

RULE No. 5 = RULE No. 3, revisited

If you don't know the needs of your cactus, plant it in mineral well drained soil – but without limestone!

a) if the plant "craves"- then add organic compounds to the mix!

b) if the plant gets "pumped up"- then add limestone!

Strombocactus disciformis ssp. *disciformis*

Starting from this amendment, considering all above statements and rules, there is one more thing that we can rule:

RULE No. 6

A well balanced mix is defined by optimal proportions between mineral compounds (with or without limestone) and organic compounds.

COMPOUNDS AND WEIGHTS

A mineral mix can include a variety of compounds favoring – generally speaking – a pH ranging between neutral to acid (cracks of metamorphic, sedimentar, magmatic, compact, porous, and consolidated rocks, and a large variety of cracks made of expanded eruptive volcanic rocks).

Strombocactus disciformis ssp. *disciformis* – a crested specimen in habitat

Compounds

1. Mineral compounds

Akadama is a clay rock, almost baked by volcanic heat, having a granular aspect, specific for Japan; it is generally used for horticultural purposes, and especially used as main soil ingredient for bonsai trees. It is very praised for the excellent drainage but also for retaining moisture inside the granules; it also has the capacity of slowly releasing microelements when worked by simbiontic bacterias. **Akadama** is very useful for the cactus grower as it has a wonderful property – changes colour depending on the hydration levels (and therefore acts as moisture indicator in bonsai culture). Unfortunately, after few years **akadama** (if used as main ingredient or in pure state) becomes useless because of compacting and losing therefore the drainage capabilities. If only used as a minor compound (recommended in cactus culture) **akadama** will not affect the lifetime of the mix. It also is a relatively expensive product.

Andesite is a magmatic eruptive rock of intermediate sub-alcaline composition, with aphanitic to porphyric texture, placed inbetween basalt and dacite. It is dominated by plagioclase (calcium and sodium compounds) but also contains numerous other iron and magnesium compounds. The dosage can be generally much higher than of basalt, 2–8 mm grades recommended.

Basalt is a magmatic alkaline (basic) rock (hence the name) with alkaline to sub-alkaline prioperties. It contains several calcium, iron and magnesium compounds, all very useful for our plants; it may also include **feldspat**, this being another alkaline rock. Traces are welcomed in our mix, but not relevant quantities! 2-8 mm grades are best.

ATTENTION to the dosage, be rather parsimonious!!!

Calcareous tuff is a natural rock resulting from chemical precipitation formed in water saturated with Calcium carbonate; it is almost pure Calcium carbonate deposited mainly on living supports – like several mosses (e.g. *Fontinalis antipyretica*). **Calcareous tuffs** are fossiliferous deposits.

ATTENTION!!! It has – when presented as rubble – the general aspect of **volcanic tuff** (see term) and can be confused with it; it is almost pure Calcium carbonate and therefore extremely dangerous for potting mixes. **Do not use – not even for calciphyte plants!!!**

Clay is a sedimentary rock made of silicates, mica, and fine quartz sands; **clay** is wide spread and abundant in several places and can have – depending on the composition – different colours. The best for cactus culture is the black-bluish quarry **clay**. **Clay** contains numerous microelements and other compounds necessary for our plant's well being. Unfortunately **clay** is quite watertight and therefore has to be used especially as dry or burned granules, or as exfoliation plates above the actual mix. Using **clay** as powder or finer grades presents a high risk because of rapid soil clogging leading to the ruin of drainage. For maintaining a good drainage is therefore recommended not to exceed 5-7-10% in the mix, depending on the species or mix quality we want to obtain.

There also is **expanded clay** available, usually in form of granules, which is a baked industrial product (like **vermiculite** or **perlite** – see the terms) – the usually available grades are rather too big: 10-20 mm. It is useless in my opinion for smaller plants, but can be useful for strong plants planted in big pots or in raised beds or directly in soil (see also **seramis**).

Clay bricks are an industrial product resulted from baking different sorts of **clay** at high temperatures; it is a very porous material, extremely friendly for the roots of the plants. **Bricks** soak up excessive moisture while plant roots can retrieve it when the mix dries up taking in also the precious microelements. Grades 3-8 mm is recommended, it is also advisable to wash it very good before mixing it as brick dust poses the same danger as fine clay.

Dacite is a magmatic rock with intermediate composition between andesite and rhyolite; it contains silicates and feldspat and is in my experience – at least for Romanian climatic conditions – an excellent substrate which can be used in up to 65-70% from the mixture (if other mineral compounds are not available). Grades 0.2 – 5 mm.

Dolomite is a sedimentary rock often misnomed as limestone, consisting in fact of calcium magnesium carbonate and being sometimes named dolomitic limestone. **Dolomite** is usable in mixes prepared for calciphyte plants, mainly because of its magnesium content. Grades 3-8 mm.

ATTENTION!!! to its high solubility! It has to be used in lower ratios than **limestone**!

Feldspat is very useful in mineral mixes, but not in large quatities because its natural alkalinity is not tempered by organic compounds of vegetal decomposition as it happens in enhanced agricultural soils; however, it contains many useful microelements like: B, Ba, Ca, K, Na, NH4 NH_4; Grades 5-8 mm.

Granite is a very common magmatic rock with acid reaction; compared to **feldspat** and **mica**, **granite** has a higher content of microelements and compounds loved by lithophage plants, like: CaO, FeO, Fe_2O_3, K_2O, MgO, MnO, Na_2O, P_2O5, Rb, Sr, TiO_2.; **granite** is as good as **dacite** in soil mixtures and ideally both should be used in equal parts. Grades 0.2-8 mm.

Gravel is – like **sand** – an aluvionary rock, being (to be more specific) a particular range of **sand** (see the term – but excluding marine organogenic **sands**) with larger grain size. It behaves different from sand – if **sand** is a water retainer (due to its capillarity), **gravel** disrupts water retention; however, its smooth surface and somewhat spheroidal graines provide for a certain unwanted property – it retains a thin film of water which is not being absorbed in the mass of the mineral and which (for reasions I don't know) becomes a highly favourable environment for anaerobic bacterial cultures. Gravel can still be used as a minor ingredient in soil mixes if you don't have the alternative of using mineral rock debris.

I DO NOT support using gravel or coarse round-grained sand (grades 2-3 mm or even bigger) in soil mixes, but ragged rocks or aggregates (no matter the grades). Being an alluvionary rock, **gravel** still can be used in organic mixes – conditional and rather tolerated than desired. For example – plants belonging to *Coryphantha* subgenus (included in the homonym genus) accept (with some exceptions!) aluvionary rocks; plants belonging to *Lepidocoryphantha* subgenus (also included in *Coryphantha* genus) need mineral rock debris and won't tolerate aluvionary rocks

Gypsum is a very soft mineral composed of calcium sulfate dehydrate, being found in nature as a sedimentary rock resulted from evaporation; **gypsum** is highly soluble in water and has a reduced hardness, being very brittle. **Gypsum** formed from sediments after evaporation of sea water from large surfaces; it contains several other chemical compounds and many microelements; these microelements are particularly beneficial for gypsophile plants, not the gypsum as such; use grades 5-8 mm, preferably semi-crystallised **gypsum**.

ATTENTION!!! **Gypsum** takes up huge amounts of water and therefore we have to make sure that we not overwater plants growing in soil mixtures containing **gypsum**, knowing that gypsophile plants are – as a general rule - highly water sensitive.

MORE ATTENTION!!! DO NOT USE builder's gypsum, but **natural gypsum only!!!**

Kanuma is a mineral substrate similar to **akadama** (see the term) and is also of Japanese origin; it is often used in professional environments like garden centers for plants needing very well drained and acidic substrates; it is recommended in mixtures for plants having these requirements (especially for South American). It is relatively expensive.

Kiryu is a **sand** type originating from Japan, used there mainly for decorative conifers, sometimes also for cacti. It is expensive and useless.

Lapilli/Lapillo *** is a form of *tephra* (Greek for ash) with a grain size between 2 mm and 30 / 64 mm (depending on this, the different names). Lapillo is a volcanic eruptive pyroclastic rock with a similar composition with **pumice – rhyolite**, **dacit** and **andesite**. When compacted (this could be an aging process or due to high pressures) it becomes a **lapilic tuff**, this is a non-homogenous **tuff**, containing smaller and larger particles. It is a very good ingredient for a soil mix, but can also be replaced by plain **tuff**; also it shouldn't replace **dacite** / **granite** / **micashist** as often recommended on forums where cacti cultivation is **not** dissociated from artificial feeding. There are only commercial sources available and this makes **lapillo** a rather expensive ingredient for an amateur.

Lava is a generic name for solified magma that was brought to the surface by volcanic eruptions; some of the rocks mentioned here are the results of such eruptions (like **andesite** or **basalt**); sometimes in *gardeners slang* **pozzolana** (see term) is simply called **lava**.

Limestone is a sedimentary rock composed mainly of calcium carbonate and is usually of organic origin (organogenic) – mostly skeletal remainders of marine animals such as corals; however, **limestone** rocks may include some other minerals such as: **clay** (aluminium, magnesium, iron, calcium, potassium and sodium compounds), **dolomite**, **sands** and **quartz**. Recommended grades: 2-8 mm.

I do **NOT** recommend **marble** rubble for potting mix; it does not have the same properties as **limestone**, and is not even neutral. In soil mixes **marble** reacts randomly, depending on the plant, unbalanced, its reactions are not predictable and cannot be correctly assessed. However, traces of **marble** can be used for North American cacti (it "spices"up the mix) as it has a very limited solubility; it is slowly dissolved only by very acid soils or by the roots working in symbiosis with bacterias producing the necessary enzymes for dissolving **marble**. I am not arguing the advisability of using it in potting mixes, but I prefer by far organogenic limestone of marine origin which is very rich in various minerals and microelements.

Loess is an unconsolidated sedimentary rock consisting of erosion materials, mainly siliceous and clays. It is very fertile and contains numerous microelements; however, **loess** is **NOT** to be used as such in soil mixes >>> first it has to be soaked in water, then kneaded and let to dry out (or even better baked); only broken into granules it can be used in soil mixes; in natural state it behaves similar to **clay** or **brick dust**, ruining the drainage.

Marlstone (Marl, Marne) is a sedimentary slaty rock, its main compounds being clays, limestones (carbonates), sometimes gypsum and even salt. **Marlstone** is completely unadvisable, except in the mixes prepared for calciphyte plants, with the condition of not using **limestone**! Grades 5-8 mm.

Mica is a group of extremely prevalent sheet silicate minerals, containing numerous other minerals benefic for plants, like: K, Na, Ca, Mg, Fe, Li etc; it can be used in the soil mixes in association with **micashist** (see term) or without, coarsely rubbled and well mixed.

Micashist is a metamorphic rock containing plenty of **mica** crystals and a long list of minerals extremely important for plants'well being – here are just few of them: TiO_2, Fe_2O_3, FeO, MnO, MgO, CaO; Na_2O, K_2O (and the list goes on); apart from this **micashist** has outstanding physical properties favouring absorbtion of water, and therefore it is recommended as one of the most important ingredients used in the preparation of soil mixes. Grades 0.2-8 mm.

Perlite is a hydrated amorphous eruptive volcanic natural glass which is artificially expanded further at high temperatures increasing its water storing capacity. It occurs naturally and has the unusual property of greatly expanding when heated sufficiently (therefore the commercial available products are actually industrial minerals). It has a wide horticultural usage as support or as an ingredient in various mixes. It contains: Na_2O, K_2O, Fe_2O_3, MgO, CaO – to name just the most interesting compounds. It is available in various grades. I was reluctant in using **perlite** because of the low density & weight making the granules to float to the surface in well watered loose substrates, sticking sometimes to the plant's body; it delivers a very untidy look to the plant-pot visual unit. However, in bigger grades it is wholesome to all soil mixes.

Pozzolana is a natural eruptive rock, made of volcanic ash and slag. It is used mainly for its draining capability and for its porosity; it is rather poor in microelements. Grades 5–8 mm.

Pumice is an eruptive expanded volcanic rock formed of **rhyolite** fragments melted together; it is the eruptive equivalent of granite as it contains **feldspat**, **dacite** and **andesite** (see the terms) and other elements like iron (Fe) and magnesium (Mg), and is characterised by a very high porosity. It is extremely useful and recommended in various weights depending on the specifications. Very often used in bonsai cultivation. Grades 3-8 mm.

Quartz – crystalline or amorphous – is natural glass; there is no plant or symbiontic bacteria able to dissole or to take in **quartz**. Industrial **quartz** (quarry or machine crushed) is not recommended to be used in soil mixes for cacti and succulent plans as it is extremely sharp and therefore dangerous for their roots; it can be used as **quartz sand**, but still has no relevance for the feeding of the plants, its only usefulness is as a neutral support ingredient. It makes no sense to use it except for dedicated purposes in few specific cases. I am aware of only two groups of brasilian cacti growing on **quartz shingle** (eroded by repreated rolling) or **coarse quartz sand**: *Discocactus* (especially *Discocactus horstii* – growing on a mixture of quartz shingle and humus resulted from decayed lichens), and *Uebelmannia buiningii* / *Uebelmannia meninensis*.

Sand is – generally speaking – a natural crumbled rock, usually silts having fine grain sizes.

I am **NOT** a supporter of using **sands**, except for very specific situation or reasons, or when there is no other reasonable alternative, because of its insufficient controllable effects; its permeability is radically changing depending on the quantity used. It definitely helps drainig organic mixes but in high quantities it is retaining too much water (its capillarity does not allow drainage or evaporation). There are sevral types of **sands** we will mention below (see also **kiryu**).

= Quarry sand is actually sedimentary river **sand** covered in time by new layers. This **sand** type is – due to its **loess** content (see term) – relatively fertile, but… also provides for an even lower permeability; however, in small quantities it can be wholesome.

= Quartz sand => see **quartz**.

= Fossiliferous sand is easily recognisable by its reddish colour; it is advisable to use it especially for South African succulents as it can contribute with important microelements if mixed in small quantities with other ingredients. It is of marine origin, but is not organogenic.

= Nisipul zis 'fosilifer' este un **nisip** specific unor zone ale sudului Romaniei, mai ale in Oltenia, usor de recunoscut prin tenta sa generala roscata; este un component bun pentru anumite plante sudafricane, iar, in amestec cu celelalte elemente minerale, in cantitati moderate, poate aduce importante contributii in microelemente, fiind de origine marina, dar nu organogena.

= Marine sand – as a result of smashing and grinding of shells or corals – is an organogenic sand composed almost exclusively of organic limestone and includes mostly calcium carbonate, but also some other interesting compounds and oligoelements. Still, it can't be regarded anything else but generally dangerous for potting mixes; however, there are few seacoast species included in *Melocactus* thriving only when marine **sand** is prevailing in their mix.

= River sand is prevailing quartz sand (see **quartz**).

Sandstone is a sedimentary rock formed by cementation of **various sands** under the enormous pressure of overlaying geological strata (layers). Depending on the consolidation it can be harder or more brittly. **Sandstone** is an excellent support for the roots of the plants and can be used to help root development of smaller plants in larger pots. It can be used as plates (placed vertically in the pot) or coarse grit or even larges pieces mixed in the soil. Grades 5-8 mm.

Scoria – see **volcanic tuff**.

Sepiolite is a complex magnesium silicate. Usually it has the appearance of a fibrous rock, or of a conglomerate of smaller particles but it also comes in compacted forms. It is commercially available as cat litter with an alkaline pH (reduced by the acid cat urine from pH 9.5 to 8.2). In its natural fibrous form it may contain **a s b e s t o s**. I have never used **sepiolite** in my potting mixes, but I am mentioning it because I can't ignore the many accounts I have read on websites and forums about its qualities especially for seed raising (!!!). There is an article - "**Sowing on Sepiolith"** - that may interest you, published in KUAS Magazine, No. 2, 1998; results of an experiment were announced to be published later on, it didn't happen as far I know.

NOTE Asbestos is a c a n c e r i g e n compound!

Seramis is actually a common name derived from a brand merchandised by the original company producing it. **Seramis** is a professional nursery product specially designed for exotic plants grown in pots, and is consists of industrial expanded **clays**; it can soak up with water but also keeps the roots well oxygenated. Among cactus growers it has the reputation of being a very good rooting medium; however, although I can't deny its properties I think that this product is slightly over-rated. Recommended to be used in potting mixes, but it is rather expensive

Shist – this is a group of metamorphic argillaceous sedimentary rocks or a simple argillaceous sedimentary rocks becoming metamorphic as a result of geologic processes; some **slates** (see term) are metamorphic **shists**. Sedimantary **shists** are excellent rooting environments (see **sandstone**) and have to be used as rubble grades 5-8 mm or plates placed vertically in the potting mix.

Slate is a fine-grained sedimentary rock – a particular type of sandstone – formed by cementation of fine **sand** granules in **clay**, at extremely high pressure. Generally used as plates, rarely as 2-8 mm grades splits.

ATTENTION!!! Slate splits are extremely sharp and can cut or bruise tuberous roots!

Vermiculite is a natural hydrated basaltic rock, artificially expanded at high temperatures and used for several industrial and agricultural purposes. Rich in Mg, Fe and Al. It is commercially available, but only higher grades are recommended in cacti culture.

Volcanic tuff is a consolidated pyroclastic rock, formed from smaller particles (especially from volcanic ash) and it has an outstanding porosity. There are different kinds of **volcanic tuffs** depending on the mineral fragments all of them being very rich in microelements. Very interesting are the rhyolitic **tuffs**, dacitic **tuffs**, and the andesitic **tuffs**; basaltic **tuffs** are usually much too alkaline to be useful. Volcanic **tuffs** are extremely useful for enhancing the characteristics of potting mixes. **Scoria** is probably the best known type of **volcanic tuff** and is commonly, but not exclusively, **basaltic** or **andesitic** in composition. Grades 2-8 mm.

ATTENTION!!! Do not confuse with **calcareous tuff** (see term)!

Zeolite is a microporous mineral consisting of natural hydrated Calcium-aluminosilicates which due to its microporosity accommodates a series of cations such as Na, K, Ba, Mg and Sr, and has a complex polymeric crystalline molecular structure. It is different from **tuff** by the way it is formed: **zeolites** are formed when volcanic ashes meet alkaline subterranean water – it takes several hundreds of thousands of years until the formation is completed. **Zeolite** is a natural ion exchanger and filter, constantly releasing in time K, a macroelement very important for plants development. More, zeolites can be artificially saturated with commercially available microelements, these being slowly and gradually released into the potting mix.

One of the last *Ferocactus lindsayi* populations

2. Organic compounds

Bone meal is a mixture of crushed, coarsely ground roasted bones and is very rich in phosphor (P) – it stimulates flowering. este un produs obtinut prin calcinarea oaselor si este foarte bogata intr-unul din macroelemente: fosforul (P) - favorrabil infloririi;

I am **NOT** a supporter of using bone meal because its influence on the pH of the mix (especially in pots) is hard to control, **bone meal** having an alkaline nature – this becomes especially difficult if not rain water is used, but any other water.

Garden earth / ploughed earth / unworked earth / loamy earth are common names used by cacti and succulent plants hobbyists used for different types of structured soil found in gardens, fields, farmlands or (especially) in uncultivated land areas, locked between the roots of the plants (see also **molehill earth**).

I am **NOT** supporting the use of **garden earth** or similar structured soils – as with **clays**, it is hard to establish the proper weight and can ruin the drainage of the mix; especially lowland earths are extremely "heavy", mostly infested with insects and other pests, and can deliver at any time unpleasant surprises.

Hashed cocos fibre is often used in horticultural production stations, usually soaked up with nutrient liquids; it is an inert support better than peat (it does not dehydrate), but still inert, with no nutritive value whatsoever. There is no reason why to use **cocos fibre** in mixes for esquisite plant collections, although it probably has its value for commercial growers.

Leaf mold is a semi-structured or unstructured soil resulted from fungal breakdown of shrub or tree leaves; it is a form of usually dry, acidic and low in nitrogen natural compost:

= leaf mold from beech or mixed beech / fir woods, if well decomposed, is in my opinion the most valuable humus supplement to cacti mixes; its weight can vary to up to 35% from the mix, for epiphytes even 50-80%;

= leaf mold from conifer woods (fir, spruce fir, pine, water-pine, cypress, tuia) is also very good being rather acidic, but is harder to acquire or to collect;

= leaf mold from oak woods contains too many tannins and is not recommended, unless used in very low weights for organic soil mixes; pamantul de frunze de stejar contine prea multi tanini si este contraindicat, daca este folosit altfel decat intr-un procent mic, in amestecuri de soluri organice;

= leaf mold from poplar, willow and acacia woods is **NOT** recommended as it is too alkaline.

Molehill earth is the earth elevated by moles (*Talpa europaea*) at the surface when digging their tunnels. It is similar to the **garden earth** (see trem) and is a very fertile soil as it usually includes the dejections of the earthworms (one of the most powerful natural fertilisers) usually living in areas where moles dig their tunnels.

Organic compost is composed of organic materials derived from aerobic decomposition of various vegetal materials. By using adequate ingredients (and producing a certain carbon to nitrogen ratio), equipment (i.e. compost bins) and texture and pH control materials (i.e. sand, clays, garden lime, bone meal, many commercial conditioners and accelerators) a very rich but permeable soil can be produced. The **organic compost** is an excellent soil conditioner in gardens but it can be used also for the preparation of organic potting mixtures for cacti and succulents; it is usually very rich in nitrogen (N), so be mindful when you use it. There is commercial **organic compost** available, covering a wide range of qualities; make sure you pay a bit of attention and check quality especially when you switch brands. (Don't confuse for commercial potting mixtures – this is exactly the stuff we don't want!). However, using a commercial product would be only a second option. Best advice – prepare it yourself!

Peat (blonde, black, red) is a hyperacidic soil resulted from an inhibited decomposition of (mostly) mosses or marsh vegetation in anaerob and high acidic conditions. Depending on the decomposition state **peat** can be fibric, hemic or sapric – the first being less decomposed, the later being the most decomposed. **Peat** is an inert soil with no nutritional value whatsoever.

I am **NOT** supporting the use of **peat** in soil mixes for cacti and other succulents, for two good reasons:

= I consider that all ingredients in the soil mix have to play an active role in a plant's life and development; the presence of an ingredient not contributing to the plant's intake and nourishment needs to have obvious, well defined reasons.

= once dehydrated **peat** will not completely rehydrate except when boiled or after prolongued immersion, which is virtually impossible in pots... especially after a three odd months dry winter rest.

Well-composted manures – (only sheep or cow manures composted for several years) – is an organic compound successfully used in plants cultivation; however, it is totally unadvisable for cacti culture, not to speak of other "recipes" like poultry dejections composted in water!

I am **NOT** supporting the use of fertilisers of animal origin for cultivation of cacti or other succulent plants because of three major drawbacks:

= they always are a high risk vector for infections;

= they always have an excessive nitrogen (N) content; this leads to a loss of any natural resemblance or to the hypertrophy of the plants, these becoming on the long run less resistant to deseases and parasites;

= there is a pardox – in moderate weights it already gives an alkaline reaction to the soil. Who wants to extra feed the plants will certainly find professional products available contaning a well balanced mix of nitrogen, phosphor and potassium (N, P, K) together with microelements, which is acceptable.

DO NOT forget that we grow our plants in pots, not in vegetable patch gardens! We grow cacti, not tomatoes or cucumbers!

Mammillaria geminispina

Potting mix ratios – a rule of thumb

Ratios are specific. However, it is a rule of thumb that rock shingle, split or crush needs to have a weight of at least 50% from the total. All other ingredients can have the rest. As a rule of thumb (and not having an universal relevance):

Clay can NOT exceed 5-7-10% of the mix (10% - for soil mixes prepared for certain *Astrophytum* species).

Limestone can NOT exceed 15% - maximum 20% [in potting mixes for *Mammillaria plumosa* or *Ariocarpus scaphirostris* (*scapharostrus*) this weight can be exceeded].

For some *Rapicactus*, *Geohintonia*, *Aztekium* and some *Turbinicarpus* species,

Gypsum CAN make up to 15-30%.

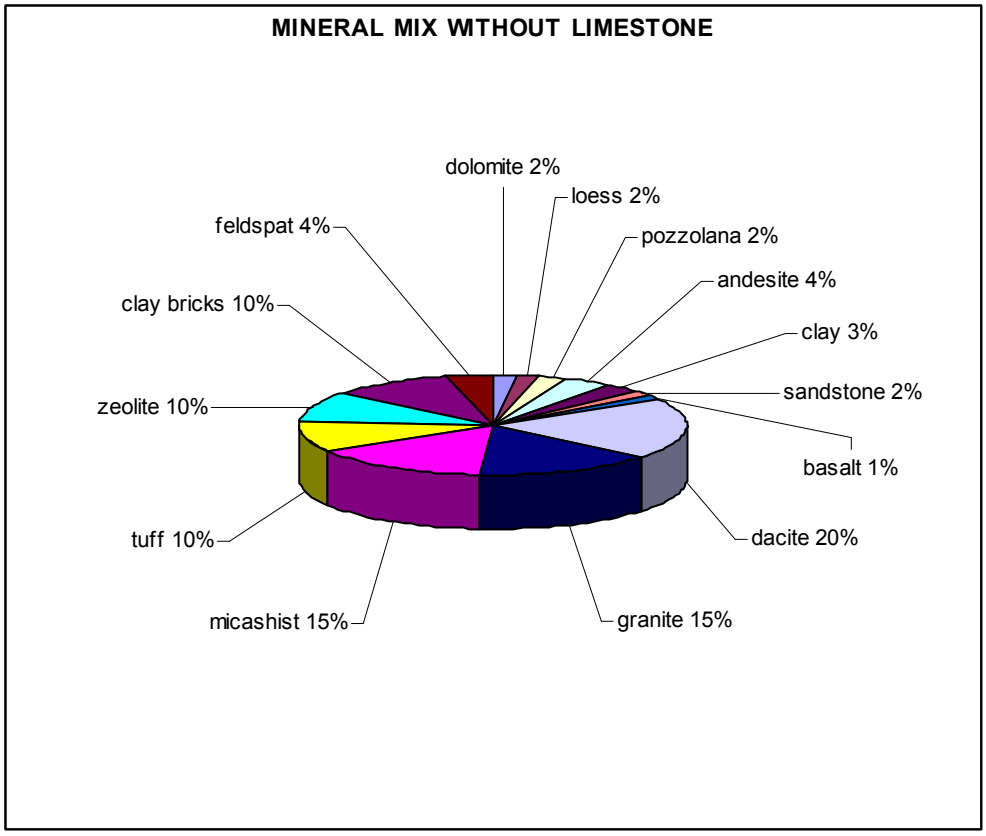
For plants previously grown on peat or other substitutes like hashed cocos fibre, I recommend for the first season repotting in a 80% mineral and 20% organic mix, and two or three times during the season fertilised using general cacti fertilisers at 50% strength. During the second season fertilising will be ceased, and for the third season plants will be repotted using 100% mineral mixtures.

Below – as a rule of thumb – I will present few soil recipies thought as a well homogenised mixture, with its ingredients evenly distributed in its mass.

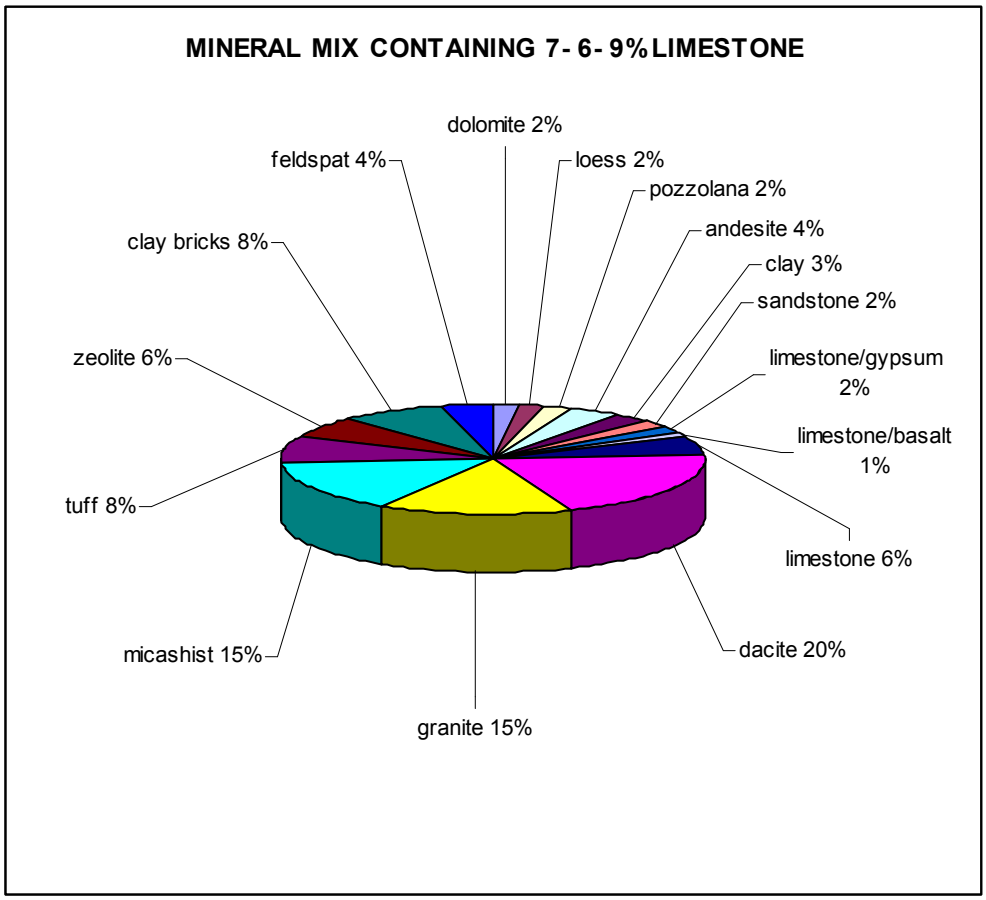
The weights as shown in the graphs below are in liters, not in kilograms (volumetric measurement). Therefore – all below recipies are in litres of mineral/organic compounds to a total of 100 litres of mixture!

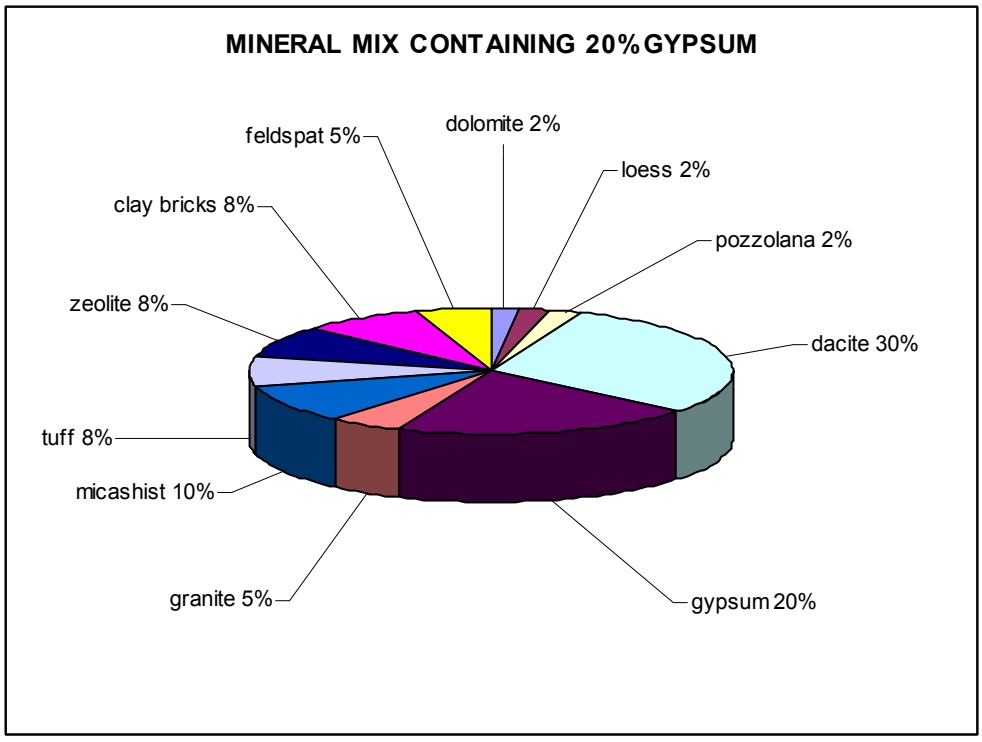
The mixing of the ingredients can be easily done – for reasonable small quantities – in mixing trays or by stirring them in plastic bags.

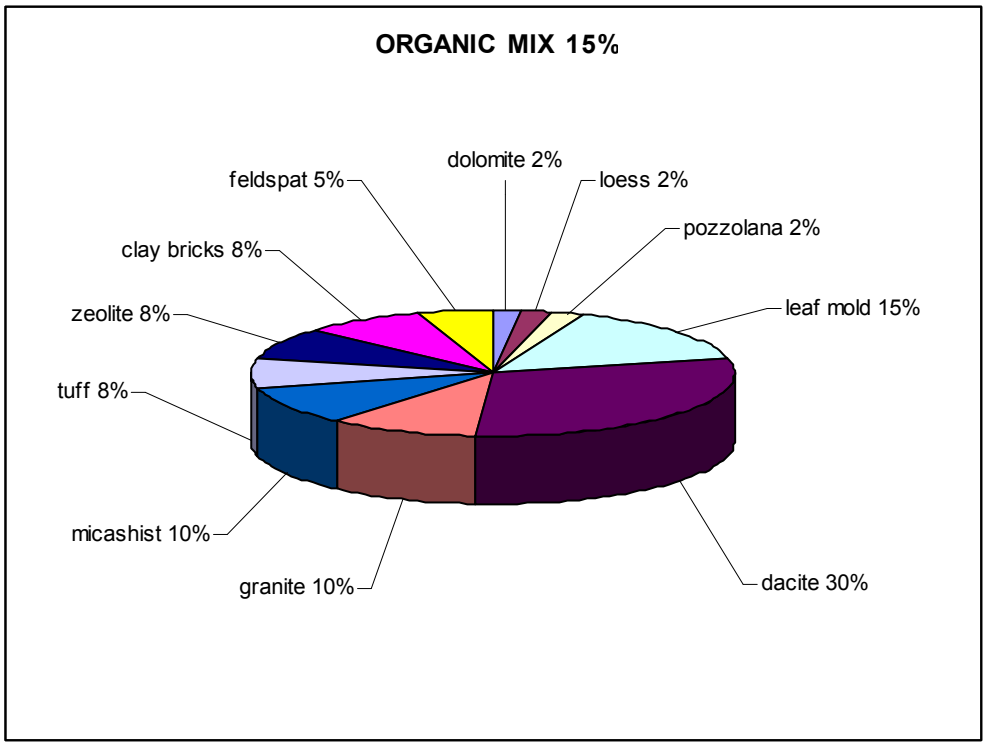
For best results prepare the mix in 100-200-300 litres batches, especially if you use some of the ingredients in weights not bigger than 1-2%. For reasonable big quantities it is advisable to use mechanic equipment such as concrete mixers; for accurate dosage of the ingredients you can use a 10 liter graduated bucket. If mechanical mixing equipment not available for you, shovel the heap as best you can (at least 5-6 times) – this is absolutely necessary!

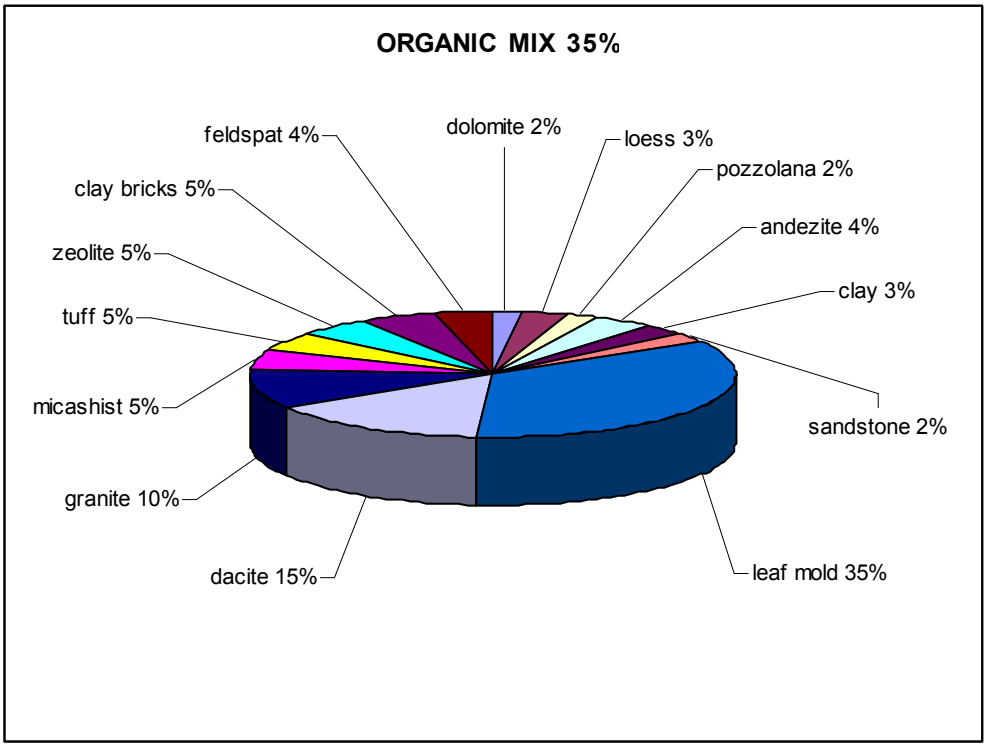


To this "basic mix" you can add various ingredients such as limestone, gypsum or organic compounds as shown below:


MINERAL MIX CONTAINING 7-6-9% LIMESTONE
dolomite 2%
feldspat 4%
loess 2%
pozzolana 2%
andesite 4%
clay bricks 8%
clay 3%
sandstone 2%
zeolite 6%
limestone/gypsum 2%
limestone/basalt 1%
tuff 8%
limestone 6%
micashist 15%
dacite 20%
granite 15%


MINERAL MIX CONTAINING 20% GYPSUM
feldspat 5%
dolomite 2%
loess 2%
clay bricks 8%
pozzolana 2%
zeolite 8%
dacite 30%
tuff 8%
micashist 10%
granite 5%
gypsum 20%


ORGANIC MIX 15%
dolomite 2%
feldspat 5%
loess 2%
pozzolana 2%
clay bricks 8%
leaf mold 15%
zeolite 8%
tuff 8%
micashist 10%
granite 10%
dacite 30%


ORGANIC MIX 35%
feldspat 4%
dolomite 2%
loess 3%
pozzolana 2%
clay bricks 5%
andezite 4%
zeolite 5%
clay 3%
tuff 5%
micashist 5%
sandstone 2%
granite 10%
dacite 15%
leaf mold 35%

SOME PLANTS AND HOW THEY RELATE TO THE POTTING MIX

This article is far from being a cultivation advice and it also was not intended to become an exhaustive and ultimate soil recipes handbook covering even the most special mixes as some *Discocactus* or *Uebelmannia*, *Rapicactus* or *Geohintonia,* and *Aztekium*, *Ariocarpus scaphirostris*, *Mammillaria plumosa* (and the list may long continue) demand.

To accommodate such extremely needy and sometimes very difficult plants, always rare and expensive, every hobbyist has to research and to study thoroughly all available and reliable sources, and only after this he has to apply the **principles** I have stated above.

However, in to all that I have already written here, few explanations are necessary.

Gypsum is needed only by few rare and difficult plants. A certain group of *Turbinicarpus* species gives the most common encountered gypsophiles – the best known in collections being *Turbinicarpus hoferi*, a cactus growing in pure gypsum crevices (see below).

As I wrote before, for some *Rapicactus* and *Geohintonia* species, for *Aztekium hintonii*, *Aztekium ritteri* and some *Turbinicarpus* species, gypsum can be added to up to 15-30% of the total potting mix and provides for an adequate substrate (in nature there are locations where these plants grow on pure gypsum).

Don't confuse gypsum with limestone, even if both are calcium compounds.

Geohintonia loves calcium, but if limestone is added to the potting mix the plant will simply die. It seems not to tolerate the alkaline reaction of limestone. In nature this plant grows on gypsum which generates a neutral pH, or, depending on the other impurities found, even slightly acid.

Rapicactus beguinii can be also found growing directly on gypsum. For all *Geohintonia*, *Rapicactus*, etc., but also generally true for all plants growing on gypsum cliffs:

DON'T use industrial or medicinal gypsum! Never and for no reason!!!

Because calcium and gypsum are so different there are many Mexican species that cannot stand limestone, but accept gypsum.

If we give them limestone (a calcium compound) – it acts like a growth inhibitor, or even kills the plant.

If we give them gypsum (also a calcium compound) – the plants will not be too affected (if substrate pH stays around neutral values) or will simply thrive (if pH swings to slightly acidic).

Aztekium ritteri – growing on a vertical gypsum cliff face

Brachycereus nesioticus – growing on lava flows on Galapagos Islands

A few remarks on certain gypsophile plants

To the most difficult gypsophile species belonging to a rather calciphyte genus (*Turbinicarpus*) we can mention:

***Turbinicarpus lophophoroides* (Werderm.) F. Buxb. & Backeberg 1937**, grows equally on gypsum dominated substrates and on limestone dominated substrates – but it is relevant that gypsum is always present. It is often considered the most difficult *Turbinicarpus* to grow, because of its special cultivation needs. Cultivation is difficult especially when some of the features occurring in its natural habitat - special soil conditions and prolongued draught interrupted by short floodings or immersions – are not re-created in cultivation. Therefore I recommend the following substrate type: mineral potting mix containing 10 – 30% natural gypsum and (after Donatti and Zanovello) it is essential that 10% humus is added to the mix. However, personally I have **NEVER** added humus for this plant, although I had always very god results.

***Turbinicarpus jauerningii* Frank 1993** loves also gypsum but, it is true, grows in areas where limestone rich clays are dominant; however, small amounts of gypsum are always found in the substrate. It grows usually in crevices or at the base of cliff faces.

***Turbinicarpus hoferi* Luthy & Lau 1991** is a true gypsophile having particular adaptations to this substrate type. In its natural habitat gypsum is rich in microelements and especially in iron oxides. It is not easy in cultivation, starting with its slow groth rate. I recommend a mixture of 30% gypsum, 60% various mineral shingle or splits, 10% clay and no humus. Some growers add up to 35% humus in order to obtain a sustained growth rate (but also disfigured plants). I do **NOT** recommend this type of cultivation, not only for its relatively unsafe approach, but minly because it does not produce plants with a natural aspect.

Gypsum has the capacity to retain water for a reasonable long period of time, and this can lead – beside the positive aspect of releasing slowly moisture and thus supporting the growth and development of the plants - to serious accidents. Gypsophile plants have to be kept light on water because gypsum never reveals how much water was taken in. The use of gypsum in pottig mixes is recommended only to growers having an extensive experience in recognising the immediate needs of a plant.

Therefore, **if using gypsum, be careful with the water!**

Here is an example of plants being grown in different manners. The plant in the middle was grown as described above, but with no organic input at all, while the other two didn't have enough limestone in their potting mix and have been generously watered - *Turpbinicarpus lophophoroides*:

Turbinicarpus lophophoroides – the general aspect of the plants reflects the way they have been cultivated.

As you van see the first two plants (left and center) have a similar age – over 20 years – and are similar sized, both being exceptional specimens. However, they look rather different. The plant on the left was lacking limestone, but was generously watered and fertilized instead. The plant on the right was also grown in a substrate with no limestone; if not tempered with limestone it will grow – in time – exactly as the plant on the left. The optimal form – true to plants in the wild – has been achieved only for the plant in the center.

Few other plants

Because of my obsessive support for mineral potting mix, it was understood – especially in our small virtual community **** - that I might have accredited a totally untrue fact that in their own habitat plants do not have any organic compounds in their substrate, this being underlined especially for plants having the reputation of being difficult to grow, and especially for *Ariocarpus*.

Mammillaria albiflora

Well, this is not always true! Although they usually grow between rocks, in some other location plants of the same species grow often on rich, organic substrates… but this is happening in their natural environment!

Turbinicarpus alonsoi and *Mammilaria duwei*

As they say – I paraphrase here an old adage – "*the count in the wild does not match the count in the greenhouse*": we have to acknowledge all the differences between habitat and captivity, between seasonal rain and controlled watering, between the water circulation in the soil and in the pot, between the reductive/saprophytic microflora from Mexico and the reductive/saprophytic microflora from wherever we grow our plants.

The impact of the differences between habitat conditions and captivity conditions becomes more and more obvious the higher the plant specialisation is. As for any living being – the more specialised a species is, the more difficult is the adaptation to new environmental conditions.

Cacti are highly specialised plants and cacti living in areas where substrates are exposed to extreme aridity or have particular specifications (limestone, clays, gypsum, salt, etc.) have developed – as I wrote above – an unbelievable high and extremely difficult to evaluate specialisation.

Ariocarpus kotschoubeyanus ssp. *elephantidens*

Therefore, these plants will have difficulties to adapt to the new conditions; they will find it even more difficult when these conditions become vectors overloading their capabilities to interact with the new environment especially on paramaters of their maximal specialization.

As a result an *Ariocarpus* cactus living in nature on a substrate having a reasonable humus and/or clay content has all the chances not to survive similar conditions in captivity, where other abiotic or especially biotic factors have been overwhelmingly changed.

More, in nature there is a certain rhytmical circulation of water in the soil, in perfect harmony with the day/night cycle. During the night – due to the capillarity process – moisture emerges from the deeper layers, gradually moisturising the soil to the surface (the deeper, the moist it is), while during day time water evaporates from the soil especially from the surface, and decreasing in intensity in deeper soil ➔ these moisture movements in the soil allow plants to enjoy a touch of moisture for few hours on a daily basis, but remaining almost completely dry for the rest of the time. .

The amount of soil in a pot is much too small to react this way. For certain plants excessive winter dew can turn out to be deadly, while in Atacama the dew accumulating in small rock crevices is the only way plants can survive.

However, although in nature *Neolloydia conoidea*, *Mammillaria candida*, *Thelocactus hexaedrophorus* etc., grow right next to *Ariocarpus retusus* ssp. *retusus* or *Ariocarpus retusus* ssp. *trigonus*, this does not mean that in cultivation if the first group tolerates organic potting mixes, then all 'rock-eaters' display the same tolerance, only because they grow at the same locations and under the same (or similar) conditions.

Thelocactus rinconensis fma. *phymatothelos*

The main fleshy pivot tubers of the *Ariocarpus* species and the entire storage mechanism developed are an amazing and highly complex adaptation. While this highly specialisation warrants their survival in their natural habitats, it makes them extremely sensitive and exposed to certain vartiations of the specifications, even to variations that at first sight seem to be favourable.

Equally, reducting bacteria and fungi living in the soil in their homelands can be valuable allies, while some of those living outside their natural biosphere (i.e. right there in your pot) turn out to be their deadliest enemies.

Therefore when preparing a potting mix for these plants you have to be concerned first and foremost about their protection against aggressing and noxious vectors, leaving – this is a paradox – nourishment or other necessities in the middle ground.

If the potting mix they are growing in does not compel their adaptation capacity or self-defence mechanisms against inauspicious environmental factors, then how nourishing that mix is becomes a background problem and not a life or death situation.

Don't forget that mineral potting mix never wears out!

Repotting becomes necessary only if the water quality was inadequate or the root system has overgrown the pot!

Ferocactus cylindraceus

Of course, adequate nourishment is always important for our plants, but there are always surrogate solutions available. You can't say the same about… dead plants!

Therefore it is highly important to create for them an environment less demanding for their adaptive capacity, even if they have to face somewhat restricted nourishment. Being slow growing plants, cacti will grow and develop harmonious… but even at a slower rate if not enough nutrients available.

If you don't have the certainty of a balanced and nutritive potting mix (which has to be changed only when the plant outgrows the pot) then you can add in spring, after the second watering, macro and microelements to the water at half the recommended strength.

Such a "shot" – at half the recommended strength – is more than enough for the entire growing season.

Using such a cultivation system you will have the certainty of having your cacti around and thriving for decades in your collections.

Epithelantha micromeris

CONCLUSION

You will NOT have outstanding results in cultivating your cacti, unless you keep learning and informing yourself on various matters, but especially in relation to pedoclimatic facts from the natural habitat of your plants!

Of course, sometimes there is a scarcity of information, or even worse – misleading or incorrect information litters the Internet. Therefore, to gap this shortcoming, the cactus enthusiast has to focus first of all on studying at least pictures and/or videoclips with plants in their natural habitats (if field trips are out of the question) – and the Internet is an almost unlimited source of information in this regard. Films and pictures are invaluable sources of knowledge and wisdom because they allow us to understand much better the environment our plants are accustomed to, and help us to provide the right conditions so that we will be able to keep these alien plants alive.

The Czechs have understood the hidden truths of the “rock-eaters”

Last but not least - be mindful of this advice:

DON'T buy a plant unless you know for sure that you can provide the potting mix quality it needs!

… would this be maybe the 7th rule???

NOTES:

* The pH indicates the chemical activity of hydrogen ions – by measuring the pH value in a solution (in nature water is always a solution, it does not come as a pure substance) we can establish if that particular solution is acidic, neutral or alkaline.

** The water-hardness indicates the density of Ca2+ and Mg2+ cations dissolved in one liter of water, and is measured in dGH (Degrees of General Hardness), 1 dGH = 17.848 miligrams of CaCO3 dissolved in one liter of water. Keep in mind that the total water-hardness is measured, and therefore Calciumcarbonate, Calciumsulphate, and Magnesiumsulphate are all included here. The water-hardness can be permanent or temporary. Permanent water-hardness withstands boiling and is given by the sulphates, while temporary water-hardness is annihilated by boiling (Calciumcarbonate and Calcium bicarbonate precipitates). Water becomes hard because it travels through geologic layers contaning limestone, other calcareous rocks or dolomite. The water-hardness is also influenced by other metallic ions (iron, aluminium, mangan, etc.), but strictly for the practical purposes discussed in this article it is totally irrelevant to bring up this subject (an exhaustive approach was not our intention). On the other hand, if water is enhanced by the other metallic ions mentioned above or by other chemical compounds in infinitesimal weights, but is not too hard because it is lacking carbonates or sulphates (the so-called "soft" water), then it is extremely wholesome for our plants

*** English/French >>> *Lapilli*; Italian >>> *Lapillo*

**** Catus Romania = www.cactusi.com

English translation and editing by Eduart Zimer