Hi All

Here are my notes from our recent (April 15, 2019) Soils and Fertilizer discussions. I have also included, at the end, some additional related information.

The only two points we all agree upon was that there were many different soil mixes out there, and that the perfect soil mixture required good drainage.

Maurice said it best. "I have been doing Bonsai for over 40 years and I learn new things every year, so my soil mixtures change from year to year".

There were a few things, however, that different people emphasized were worth considering.

Please Note: The following information is just a starting point. Everyone needs to experiment with these factors to find out what works best for them, because different tree species requires different soil properties; and these properties are affected by local geography, climate, etc.

Always try to imagine what's happening inside the pot and the reason why you mix the soil with other soils. It's always better that way and it makes you try and find a better mix of soils for your plant, thinking of the reason why you pick the soils and how they will work.

Or, you could just check out another club member's trees – if they are healthy – maybe they will share their soil and fertilizer mix with you ☺ .

Soil Mix Factors to Consider

- **Drainage**
  - Soils lacking good drainage may result in salt build-up or cause the roots to rot.
  - New roots can grow well in soil that is loose and drains well
- **Water retention**
  - How much water the soil can absorb.
  - To supply moisture to the Bonsai between each watering.
  - Can also help the soil to keep the nutrition when added. Organic matter works best
  - Organic matter – starting with medium that retains the most water: Coconut Coir; Fir/Pine Bark; Mushroom Compost; Peat Moss (Kiln dried PM has issues)

- Inorganic matter – starting with medium that retains the most water: Diatomaceous earth; Akadama; Pumice; Turface; Vermiculite; Perlite; Sand; Lava Rock; Expanded Shale; Granit Grit.
- Need to weigh good water retention with good drainage, as some materials will break down and clog pore spaces.

- **Aeration**
  - Tiny gaps or air pockets between each particle to provide oxygen for the roots; and promote the good bacteria and mycorrhizae to interact; and process the food for the plant.
- **Fertilizer**
  - Some people add other soil that has nutrition, and some people use fertilize to add nutrition to the soil
  - Fertilizer can be powdered, liquid or solid; organic or inorganic
  - Start each spring with a weaker fertilizer
  - Fertilize the bonsai approximately three weeks after new spring growth begins until the start of fall.
  - Use a balanced granular fertilizer, such as a 20-20-20 blend, on top of the soil, re-applying when the granules dissolve.
  - Switch to a 0-10-10 mixture in the fall and stop applying fertilizer in the winter.
  - Shultz, all-purpose fertilizer 25-8-20 with micro nutrients, use a weak solution. I apply in Feb/March then come May or June, I switch to a more balanced fertilizer.
- **Soil pH**
  - Needs varies between plant type
  - Somewhere in the range of 6.5 to 7.5 works
  - However, conifers prefer more acidic soils (e.g., for pines about 6.8)
  - pH fluctuation should be kept to a minimal).
- **A secure base**
  - Angular shape to particles to help prevent tree from moving

- **Regional and local ecosystem climatic environment**
    - What are the requisites of the local growing conditions
    - We have lots of precipitation in winter; but can have long extended dry summers; and even a dry warmer March
- **How readily available is the different soil components in our area; and what is the cost?**
- **Size of pots**
    - Larger pot could have larger soil particle sizes than smaller pots
    - Need to consider overall weight of soil components – especially as we get older
- **Want a soil medium that promotes fine feeder roots**
    - Need sharp edges to promote splitting
- **Particle Size Matters**
    - Organic components may need to be shredded to reach optimal particle size.
        - All component particles should be similar in diameter
    - Ideally, particles range from 1/16 inch to 3/8 inch.
    - If particles are too small, on the other hand, they may fill in the tiny air pockets in the soil that allow air circulation to the tree's roots.
    - Special bonsai soil screens, inexpensive and readily available, let you screen out the minutest particles.
    - An exception is when you want to grow moss on the soil surface – moss prefers tiny particles
- **Drainage Soil Layer**
    - Pumice 1/2” pieces
    - Pine or Juniper: 1 or 2 pebbles thick
    - Maples: 3 or 4 pebbles thick

Different Soil Recipes

1. **Recipe #1**
    - **For Conifers**: 1 part lava rock, 1 part pumice, 1 part akadama, 1/2 cup horticultural charcoal per 5 gallon mix and 1/2 cup decomposed granite per 5 gallon mix.
        - Higher elevation conifers require a medium size mix (5/16"-3/8"). Although, this seems very large to look at, it prevents these trees from holding too much water. For lower elevation conifer and water loving conifers, one also requires a small particle mix (1/16"-1/4").
    - **For deciduous trees,** one needs to use a small particle mix (1/16"-1/4") and add 1 part akadama to it as well.
2. **Recipe #2**
    - 75% inert aggregate material and 25% organic material.
3. **Recipe #3**
    - 1 part crushed lava rock; 1 part chattachoochie -- a non-porous substance similar to gravel; 1 part Texas grit, and 1 part pine or fir bark.
    - If your tree prefers acidic soil, add two parts peat moss.
        - Half or more of the mix is composed of inorganic materials that provide air pockets in the organic and allow water to drain.
        - All the organic components, like bark and peat moss, eventually decompose, so consider their rate of decay.
4. **Recipe #4**
    - Mix together 2 parts granite grit, 1 part loam and 2 parts peat moss for a basic soil mix.
    - Alternately, for deciduous trees, mix 1 part coarse sand, one part loam and one part peat.
        - Compost can replace loam and leaf mold or finely shredded bark can replace peat.
        - Use a one-sixteenth-inch screen to sift out dust particles. Follow with a one-quarter-inch screen to remove larger pieces.

5. **Recipe #5-12** (from an Akadama distributer)
    - Akadama allows space for air so the soil and roots can breathe, kanuma holds the water inside, and peat provides the nutrients needed for the plant.
    - Example blends of soils <u>for coniferous trees</u> (ratio differences affects water retention):
        - Akadama 50%, peat moss 30%, and Kanuma 20%
        - Akadama 70% and peat moss 30%
        - Akadama 70% and Kanuma 30%
    - Example blends of soils <u>for deciduous trees</u> (ratio differences affects water retention):
        - Akadama 60%, peat moss 30% and kanuma 10%
        - Akadama 90% and kanuma 10%
        - Akadama 90% and peat moss 10%
        - Akadama 60%, peat moss 30% and sand (other grit 10%)
        - Akadama 90% and pumice 10%
6. **Recipe #13**
    - 1/3 Japanese Hard Akadama
        - binds nutrients, holds water and breaks down over time allowing roots to grown in it's place)
    - 1/3 Japanese Hyuga Pumice
        - Excellent at retaining water.
    - 1/3 USA Black Lava Rock
        - Excellent at promoting air to the root area and adds structure to the soil.
    - Horticultural Charcoal
        - Harbours beneficial bacteria and adds humic acid in the soil.
7. **Recipe #14**
    - The standard Florida mix: 50% red lava (scoria), 25% calcined clay (Turface brand) and 25% pine bark (Fafard Organic Soil Conditioner).
8. **Recipe #15**
    - Frank Corrigan’s Japanese Black Pine Soil
        - 20% Akadama
        - 40% Pumice
        - 20% Black Lava
        - 20% Granite Grit
        - Also a drainage layer

9. **Recipe #16**
    - Frank Corrigan's Trident Maple Soil
        - 20% Akadama
        - 60% Pumice
        - 20% Granite Grit
        - 20% Black Lava

Important Basic Bonsai Soil Knowledge

CEC

Note*: cec or Cation-exchange capacity is a measure of how many cations can be retained on soil particle surfaces. Negative charges on the surfaces of soil particles bind positively-charged atoms or molecules, but allow these to exchange with other positively charged particles in the surrounding soil water. This is one of the ways that solid materials in soil alter the chemistry of the soil. CEC affects many aspects of soil chemistry, and is used as a measure of soil fertility, as it indicates the capacity of the soil to retain several nutrients in plant-available form. It also indicates the capacity to retain pollutant cations.*

Organic or Inorganic Soils

Organic soil mixes can include peat or leaf-litter or bark. The (potential) problems with organic soil components is that over time organic matter will break down and reduce drainage; and if allowed to completely dry, then they absorb water very poorly.

Some people use peat moss to add acidity for certain plants. However, it retains a lot of water and should be used sparingly.

Inorganic soil components contain little to no organic matter and they absorb less nutrients and water than organic soils, but are great for drainage and aeration. It also means we only have to repot every 5-7 years.

You will hear about many seemingly odd materials to add to your mix including 'chick grit' (a crushed granite available in farm feed stores) and 'kitty litter' a type of calcined clay, as well as imported akadama clay. Lava rock and pumice are other additions used with good results.

Used properly *they all work*.

Different Soil Components

Inorganic soils:

- decomposed granite (hard, less water absorption)
- seramis (grains of crushed red brick)
- haydite (Extended shale)
- sand

Organic soils:

- bark
    - Pine Bark
        - holds onto moisture when wet
        - decomposes relatively slowly, and supplies nourishment for the tree
        - easy availability (more common in eastern North America)
        - Along with sequoia bark, pine bark frequently comes packaged as orchid soil.
    - Fir bark
        - supplies more nutrients than pine bark
        - More readily available here than pine bark?
- peat
- muck
- compost
- potting soil

Volcanic soils:

- pumice (good water absorption ability)
- perlite (good for seedlings and cuttings)
- vermiculite

Japanese Bonsai soils:

- akadama (similar to seramis)
- kanuma (pumice)
- fujisuna (pumice)
- hyuga (pumice)
- kiryu (sand)
- keto (similar to peat)

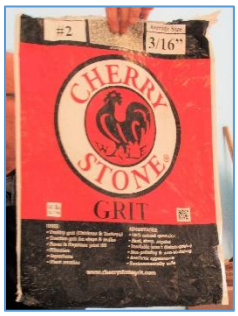
Green moss

- Can make bonsai more artistic

- Can keep the soil from getting dried out fast.
    - Can take more time to absorb water, so make sure lots of water comes out from the bottom of the pot when watering.

Bonsai Soil

Example types of bonsai soil component packaging



AKADAMA

Akadama is a naturally occurring clay-like (but not clay) mineral found only in one region in Japan. It is surface mined, dried, graded and packaged. No baking or firing is involved. When wetted it forms a gritty paste.

<u>Benefits</u>: Akadama is a great growing medium for Japanese maples and many other broadleaved species. It is beneficial in the soil mixes for most other species. Has high water-holding capacity, air conductivity and good drainage. Roots can grow through the Akadama's particles as well as between them, vastly increasing the amount of space available to the roots. Roots become very fine and form a dense pad of functioning feeding tips. As Akadama breaks down into smaller particles the pore spaces do become smaller, however, they still allow for sufficient drainage after several years in use. Comes in basically three size, small, medium and large. *Although Akadama has a relatively low cec (around 18-20 meq/100g) the fact that the roots are so prolifically generated means that this is not a defect.*

<u>Problems</u>: The biggest draw-back is cost and access. Even lower grade Akadama is priced at over $50 US per bag. It may be cheaper to purchase this material from Europe? There is little innate nutrition and slight Acidity

KANUMA:

- often used with Azaleas or grasses and other potted plants as well.
- works well for keeping water inside and water absorption
- often used with a mix of akadama soil.

KETO-SOIL (peat soil):

- has many nutrients so often used for various bonsai trees
- is a clay type soil and it's not good at taking air and water in and out, so using this soil by itself can spoil the root of the plant.
- often used for attaching bonsai to rock(adding water to the soil and make it a clay and use it as a glue. Ex, rock-grown bonsai)

COARSE SOIL

- used in the bottom of the pot for good water drainage and aeration
- usually **large akadama or pumice** is used for this.

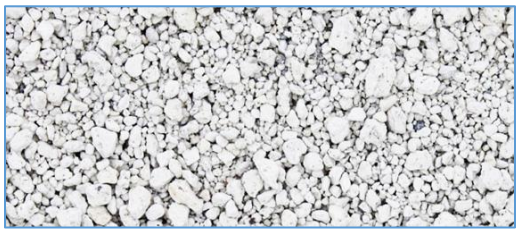
LAVA

Red or black lava from Colorado is commonly used for bonsai soils. Lava is essentially foamed glass with sharp edges and partially interconnected pores.

Benefits: Depending on its source, lava can potentially contain minerals useful to plants. *The cec of lava is highly variable, but generally hovers between 15 and 40 meq/100g.* Lava can hold up to two and a half times its weight in water but it takes several hours of soaking for the particles to become fully wetted. Roots cannot grow into or through lava particles, but they can and do penetrate the pores to a certain extent. Lava rock is cheaper than Akadama. It can also be re-used by washing, drying and re-sifting.

Problems: Lava must always be sifted and washed before use to remove any fines that may plug pore spaces.

PUMICE



Both lava and pumice are a product of volcanic eruption, but there the similarity ends. Pumice is molten rock that is blasted out of a volcano at extremely high pressure and temperature; with this rapid decompression as it leaves the volcano that gives pumice its softer texture and more interconnected pore structure.

Benefits: Pumice can hold up to four times its own weight in water. Since the surface of each particle is soft, roots do seem to enjoy their company very much, and ramify well. The roots seem to break down the surfaces of the particles to form a sort of micro environment of small particles that promotes small fine roots. *With a cec around 75 meq/100g it requires less frequent fertilizing that most other soil components when used alone.*

Problems: The easily powdered surface can result in clogging (which can result in too much water). The soft roots are unable to penetrate pumice as the surface pores are too small. Pumice drains well but tends to drain less well after a couple of years in use. However, drainage is never impeded to the extent that it becomes a problem

TURFACE

Also marketed as Terragreen or Biosorb among others, Turface is calcined montmorillonite clay. Calcining is the process of heating a substance to a temperature high enough to bring about a change in physical state. At lower firing temperatures, the absorbency rate increases. Turface is heated just enough to stabilize the particles - to prevent them forming a slurry when saturated, but not high enough to reduce its absorbency rate. Good to use as a soil amendment at a rate of no more than 15% by volume.

Benefits: Can absorb vast amounts of water. This incredibly high absorbency seems to be a good medium for newly dug trees.

Problems: As soon as the inter-particle spaces are full of roots, it readily becomes waterlogged.

Turface *substitutes* such as oil dry and kitty litter are less stable and not really suitable as a soil ingredient. *Turface has a moderately high cec of 33 - 35 meq/100g and after a while this may cause Turface to adsorb concentrations of nutrients so high that it can cause reverse osmosis resulting in "root burn". In theory this is possible, but you would have to be consistently feeding very heavily for some time for this to happen*.

PERLITE

Perlite is essentially a form of natural glass. When heated the raw material will expand up to 20 times its original volume.

Benefits: It can hold vast quantities of water. Root growth in pure perlite is excellent and it is extremely hospitable to mycorrhizal fungi,

Problems: *It has a cec of virtually zero.* It is very soft and crumbles very easily - roots can split away fines that can wash to the base of the pot and form a drainage impeding pan. It is extremely light in weight and its lightness makes it unstable as a single ingredient soil. If using perlite as an ingredient, be careful to ensure that either the other ingredients are virtually non-absorbent, or perlite forms no more than 20% of the total mix.

GRIT

Grit, gravel, sand, granite, cherry stone

3 Types of Grit Material

Size: For this discussion, grit comprises grains of stone between 1.5mm and 3mm. Anything smaller is sand, anything larger is gravel.

Grit can be - crushed granite (i.e.: chicken grit) sifted paving sand, pool filter sand, aquarium gravel - they are all inert.

Benefits: Grit is used primarily to reduce water retention in the soil in general, to aid rapid drainage after watering, and to maintain an open soil structure. It also adds weight to the soil making it a more stable anchorage for roots.

Problems: Anything smaller than 1.5mm can either fill valuable pore space in the mix, or wash to the bottom of the pot creating a drainage impeding pan. Particles larger than 3mm create pore spaces large enough to be occupied by other ingredients and take up space that could be occupied by roots. Avoid any grit that has been gathered from or near the shoreline to avoid salt which bonds to the surface and can take a long time to re-dissolve. If using chicken grit, make sure it doesn't contain crushed oyster shell, which is also high in salt content and very alkaline.