MONTHLY TIPS

(Ed.'s Note: The following article was written by Brent Walston, owner of Evergreen Gardenworks in Kelseyville, California. Please visit his website at www.evergreengardenworks.com, where he has written a great wealth of bonsai articles and carries a wide selection of plants suited for bonsai)

Introduction

Soils for container growing, and that includes bonsai, are very different from soils used in gardens and field growing. In the following article I will discuss the necessary parameters for container soils and how to use them to develop good container mixes.

Soil Basics

The study of soils is centered on the size and composition of the particles. Particle size varies *directly* with air retention, and *inversely* with water retention. This means that, as the particle size decreases, so does the amount of air retained at the saturation point. It also means that, as the particle size decreases, the amount of water retained increases

We all know this intuitively and actually work with this principle all the time in the garden. Clay soils retain more water and less air than sandy soils. Interestingly, we often use the same cure for both extremes, the introduction of organic matter. Organic matter is very good at water retention. Soil amendments, such as peat moss can hold many times their weight in water. It is obvious that this would help a sandy soil, but how does it help a clay soil?

As long as the organic matter particle size is not too small, and the amendment is thoroughly incorporated, clay soils are improved by 'aggregation'. That is, the inorganic and the organic soil particles tend to clump together to form larger aggregate particles that will trap air between them as well as water within them. This improves the aeration, or air retention of the soil. Stated differently, it improves the drainage.

Clay has a tremendous ability to retain nutrients, organic amendments have a lesser ability, and inorganic larger particles such as sand have very little. Container soils which contain little or no clay or native soil, must be fertilized regularly to overcome this deficiency. Also, soilless mixes (those that contain no native earth), will usually be deficient in trace elements, and these will have to be added in some manner.

Bonsai is a Nursery Container Practice

Bonsai is container gardening, and in that sense, is little different than general nursery work in the mechanics of soils and drainage. Soils for containers should drain 2 to 3 times faster than native soils. The earth acts like a huge suction pump and can literally pull water from heavy soils. But this same garden soil in a container is usually instant death for your plants. Because of the impermeable walls and bottom of the pot, this same soil will not drain properly. Container mixes should drain so fast that you can stand there and watch the water flow through.

Most nursery mixes these days are 'Soilless', that is, they contain no native soil, except possibly washed sand. They may contain compost. They are usually composed of three elements:

- Inorganic structural element: lava rock, perlite, sand, baked clay, decomposed granite, pumice, etc
- Organic structural element which can hold some water and nutrients: fir bark, pine bark, nitrolized redwood chips, etc.
- A water holding element (optional): compost, peat moss, or vermiculite

Water Retention and Drainage

Soils must drain quickly, but still retain a reservoir of water, 25% percent by volume is considered optimal. The air space after initial drainage (the saturation point) should also be about 25%. It is hard to beat peat moss for water retention without adversely affecting drainage. Peat moss is also effective at nutrient retention. Vermiculite after it begins to break down to its basic clay constituent is also very good water and nutrient retention, but must be used conservatively, because it is after all, clay.

Pathogens

Anytime you use compost (unless it has been pasteurized, or thoroughly composted) or native soil you run the risk of introducing pathogens, insects and other pests. If you are a believer in the necessity of these elements, pasteurize them them by putting them in an oven bag with enough water to moisten, and heat to 140F to 160F degrees (internally) for about half an hour.

MONTHLY TIPS (CONT'D)

Mixes Vary with Container Size and Species

I use several mixes for my nursery plants (including bonsai) according to the species of plant and the size of the container and also the cost of the constituents. For my liner (small starter) pots to about seven gallon size pots, I use extremely fast draining mixes because nothing is surer death to a seedling or rooted cutting than a dense soil. You should be able to easily 'see' big air spaces.

The formula is very simple: eight parts screened fir bark 1/4 to 3/8 inch size, eight parts screened perlite, one part peat moss, one half part vermiculite (optional). I also incorporate Osmocote time release fertilizer. Mixing in a cement mixer makes it very easy and pretty cheap. This is an excellent mix for bonsai, except for aesthetic reasons you may wish to replace the perlite with other inorganic structural elements such as decomposed granite, turface, pumice, etc.

This mix will dry out very quickly, but it will get you maximum root growth in the shortest amount of time.

The above mix works well up to seven to ten gallon size. The larger the container the denser the soil mix is the rule in nursery practice, until you are planting in the earth where the densest mix occurs. For ten to fifteen gallon size and larger, I substitute unscreened fir bark (3/8 inch minus it is called) for screened bark, reduce or eliminate the the peat moss and replace the perlite with 3/8 lava rock. This makes a denser, less expensive mixture that will not dry out as quickly, but since bark does not quickly decompose, it will not quickly collapse (more on this later).

This mix works especially well for slower growing species that need excessive aeration. Faster growing species will do better with a denser mix of more traditional nursery mix of nitrolized wood fiber, sand and compost. It is about 80% redwood shavings.

Most beginner gardeners and bonsai growers usually use a mix that is too dense, thinking that what grows them best in the earth ought to work just as well in a container. This is not the case.

Root Colonization and Soil Collapse

This next point, which I have discovered after years of throwing out dead nursery plants, is not obvious and will not be found in most books.

IN A CONTAINER THERE IS A RACE GOING ON BETWEEN THE GROWTH OF THE ROOTS AND THE DECOMPOSITION OF THE SOIL.

If the organic soil elements compost or decompose before the roots can completely colonize the pot, the soil collapses and loses its drainage and air spaces, and the root growth stops. If the roots fill the container first, the soil will not collapse because the roots will form a structure that will support the plant and the soil, and drainage will be maintained.

I have even seen rootballs nearly devoid of soil because of erosion, but uncollapsed because of the root network. This is not as important in finished bonsai because we tend to use premium soils with few organic elements that can collapse, but it can happen if you use too high a proportion of compost or wood fiber, other than bark (which decomposes slowly). This is a very important point for growing out plants for bonsai, where we use larger containers and less expensive and denser soils.

IN ANY SOIL MIX, TIME, WATERING, WEATHERING, CHEMICAL AND BIOLOGICAL DECOMPOSITION TEND TO PRODUCE SMALLER PARTICLE SIZE , LOSS OF AIR SPACE AND DRAINAGE.

I call this process 'Soil Collapse'. For the organic elements of the soil, this can occur very quickly. For the inorganic elements, it is usually a slower process, but can be rapid for some volcanic soil amendments and decomposed granite. It is important to match the 'soil life' with the rate of root growth to make sure that root colonization occurs before soil collapse. The root colonization rate varies with the species, fertilizer, water, sunlight, and pruning practices. These are all interdependent forces. That is, plants will *grow faster* under optimum light, fertilizer and full foliage conditions, thereby decreasing the time needed for the roots to colonize the container. Plants grown in more shade than they like, suffer greatly from this effect because top and root growth slows and soils tend to stay wetter increasing the rate of organic decomposition.

In the nursery business, soil is a large part of the bottom line and premium materials are not affordable for all plants. For fast growing annuals, perennials and woody trees and shrubs, soils that contain a high percentage of wood fiber, as much as eighty to ninety percent, are perfectly acceptable. Slower growing plants require more sand, bark, perlite, etc. that will break down more slowly.

MONTHLY TIPS (CONT'D)

After years of trying to make my plants adapt to my soil mixes, I have realized that it is much better to adapt my soil mix to my plants. I grow less and less landscape material and more bonsai related material so my mixes are now all bark and perlite (or pumice) based. I find that the collapse theory works quite well in predicting what mixes will succeed with what plants.

For a more indepth treatment of this subject see the article Aging of Container Soils.

Premium Materials

In bonsai, there is so little soil involved that cost is rarely a factor. Premium soil mix components are a small part of the bottom line. However, some components work so well that we use them anyhow, such as peat moss. Peat moss is not a necessary component but its excellent water retention makes it a valuable component in very hot areas where watering only once a day is desireable. It is often the decomposed peat that one finds in the bottom of the pot.

There is always a tradeoff in soil mix components. I prefer porous volcanic materials such lava rock, pumice, and perlite (a sort of manmade volcanic rock) because they are light weight, hold water and air and are readily available. But they do break down, and after several years one finds evidence of this in the bottom of the pot. I also use DG, decomposed granite. You can screen it to get any particle size you want to get excellent drainage, but some grades break down rapidly. I have been very lucky to obtain a grade that has probably been mined from a source near water, so the weathering has been minimal and it is very stable. On the minus side, it is heavy and has no water retention.

AND FINALLY

After fifteen years of this, I am still playing with soil mix formulas and this seems to be true of most nurseryman, so there will probably never be an end to this thread.

For more soil mysteries explained, see the companion article Why the Earth Is Not Like a Pot.