Soils & Nutrients for Indoor Plants

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Soils & Nutrients for Indoor Plants
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for Indoor Plants

SOILS

Soil is not uniform in its ingredients or in the way those ingredients work in combination with each other. And, not all plants will grow well in the same soil mixture. In fact, most indoor potting mixes do not contain soil at all. Instead, they consist of organic materials (things that were once alive) such as bark (usually pine, fir, or redwood) and peat moss, and inorganic materials (things that were never alive) such as clay, perlite, sand, and vermiculite. A good potting mix should be light enough for good drainage and aeration of the roots, yet heavy enough to retain moisture and nutrients.

Potting Mixes

The materials that are most frequently found in indoor potting mixes are:

◆ **Sphagnum Peat Moss.** This organic substance is made of partially decomposed material and is usually acid, with a pH in the range of 4.0 to 5.0. It has no nutritive value, cannot support a plant by itself, and must be mixed with other materials. It is added to potting mixes for its water and nutrient retaining abilities.

◆ **Perlite.** This white siliceous rock is lightweight and porous and resembles styrofoam pebbles. It often makes up as much as 1/3 of the potting mix. It is used to keep the soil aerated and draining well, while at the same time retaining three to four times its weight in water. It has a pH of 7.0 to 7.5.

◆ **Vermiculite.** A mica product, this inorganic material is sterile and lightweight, coming in different sizes, the larger ones being preferable for use indoors as they provide better soil aeration. Vermiculite contains calcium, magnesium, and potassium. Helps retain air, nutri-

ents, and water, and promotes lateral movement of water in the container. Its pH is closer to neutral, ranging from 6.5 to 7.2.

◆ **Manmade.** Some potting mixes contain manmade substances used to enhance moisture retention or drainage, such as hydrophilic polymers which increase water retention and assist in aeration and drainage; or polystyrene beads which serve no discernable purpose, are not biodegradable, and should probably be avoided.

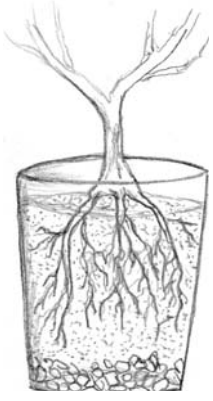
Do not use garden-grade potting soils indoors. These would need to be pasteurized before using indoors, and you don't really want to do it yourself if you can just go out and buy something that is already sterile.

When using subirrigation devices, check with the manufacturer to see if they recommend a particular type of potting mix for their systems. When planting in open beds in atrium settings, palms or other large specimens may demand a particular type of media that is heavy enough to support the height and weight of very large plants, and that will not dry out between waterings in these often warm environments.

Because a commercial mix of peat moss, perlite, and vermiculite does not contain any real soil, it may have some slow-release fertilizers added to it. If it does not, or if you make your own mix, you must add fertilizer, one that contains both macronutrients and micronutrients.

Retention & Drainage

Most indoor potting mixes retain moisture and drain off the excess moisture. If a plant requires better drainage or better water retention, you can add peat or humus to increase water retention, or add sand or pumice to improve drainage.



You can protect the roots at the bottom of the pot from sitting in water by adding terra cotta shards or a layer of charcoal or gravel in the base of the pot. Charcoal works well because it also absorbs excess salts (minerals from fertilizers) and decayed matter.

Plastic pots retain moisture far better than unglazed terra cotta (clay). However, clay drains better and also leaches soluble salts (excess minerals) through the clay. This makes the clay pot unattractive with white stains all over it but, in the end, it is healthier for most plants, as long as they are not allowed to get too dry between waterings.

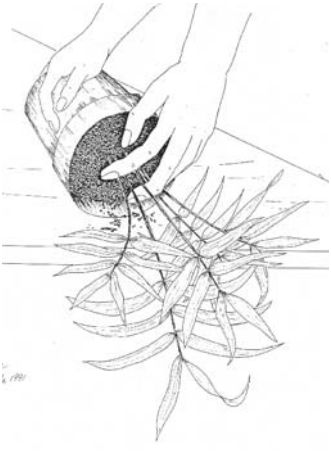
Cultivation

Outdoors, soil is cultivated with a hoe or a trowel, turning it regularly to improve aeration and to prevent the soil from becoming compacted. Indoors, most commercial potting mixes will not compact, and so they do not need an enormous amount of cultivation. And some of the heavy clay soils in which palms are grown could not be cultivated if you tried. Ditto on the volcanic rock mixes from Hawaii-grown dracaenas. But some planting media do require cultivation. Use a small trowel or large spoon, and do not dig more than an inch or two into the mix. Do it gently at first to make sure you do not disturb the roots.

If you have plants in subirrigation devices, you know that the water is coming up from the bottom of the pot, not from the top. In this case, the top surface can become hard or can degrade entirely over a period of a few years. Cultivation is not necessary, but it may signal that it is time to transplant.

Transplanting

There are different ways to improve the soil or planting mix in a container. You can completely remove the plant from the container, brush the old soil off the roots, and either put it back in the same container (a soil change) or a bigger one (a transplant) with fresh soil or potting mix. Or, you can remove only the top two to six inches of old soil or potting mix and replace it with fresh.



The decision to do one or the other is based entirely on the individual circumstances of the planting. With very large plants, removing the upper inches of soil is often preferable. Small plants that are outgrowing their pots need to be potted up a size. Slow growers that are rootbound and need to stay in their existing decorative container will likely benefit from a slight root trim and new soil in their old pot.

When transplanting a plant with a delicate root system, such as a *Ficus benjamina* or a *Polyscias* ("Ming aralia"), you may need to protect it from possible transplant shock by applying some Vitamin B-1 to the soil. Be sure it is mixed with water in a very light concentration and that you apply it only to damp soil. Most transplant shock is actually just a result of insufficient water in the new soil, either because it is a less water retentive mix than used previously, or more likely because the plant was not watered sufficiently after transplanting – or a combination of both.

Texture

Texture refers to the relative sizes and distribution of the mineral (soil) particles which affect the aeration and water absorption of a soil. Normally, this refers to the proportions of clay, sand, and silt. Since you may have occasion to use something other than a non-soil potting mix, some knowledge of the components of soil would seem to be in order. You can begin by looking at the table on page 25, which defines the various soil mixes by the percentages of their components.

The size of clay, sand, and silt particles are defined within limits set by the United States Department of Agriculture (USDA):

Sand	0.05 mm to 2.0 mm in diameter
Silt	0.002 mm to 0.05 mm in diameter
Clay	>0.002 mm in diameter

Sand can vary, and the USDA places size limits on it too:

Very Coarse	1.0 mm to 2.0 mm in diameter
Coarse	0.5 mm to 1.0 mm in diameter
Medium	0.25 mm to 0.5 mm in diameter
Fine	0.10 mm to 0.25 mm in diameter
Very Fine	0.05 mm to 0.10 mm in diameter

In addition, soil texture is defined by its coarse fragments, each having a specific definition that reflects its composition, shape, and size. The coarse fragments each have specific terms to describe them, such as cherty (like chert, a hard, dense silica rock), cobbly (like cobblestone, a rounded hard stone once used for paving streets), flaggy (like flagstone), gravelly, slaty (like slate), or stony.

Gravelly	2 mm to 75 mm in diameter
Cobbly	72 mm to 250 mm in diameter
Stony	>250 mm in diameter

Fine-textured soils have a greater surface area than do coarse-textured soils. In other words, clay loams have a greater surface area than do sandy loams. A soil that has a greater surface area generally has more water and nutrient absorption qualities. When you add more clay, a soil increases its ability to absorb water and nutrients. However, while it may seem like a favorable thing to be more absorbent, the additional clay also decreases the space in which the water and air can move within the soil, and that is not as favorable a trait.

The USDA publishes a textural triangle called the Bienz Soil Chart, which shows the twelve soil textural classes. There are also another twelve soil types that appear in some books, and they are: average, bog, fertile, gravelly, heavy, light, loose, organic, poor, rich, rocky, sandy, and various.

To determine the texture of a soil, some people use the sense of touch. However, this is not as precise as a mechanical analysis in which the soil particles are physically separated by means such as the pipette method (accurate but time-consuming), Bouyoucos

hydrometer method (widely used but not as accurate as pipette), or wet sieving (determines the amount of sand in a soil).

The pipette method relies on the Stoke's Law equation:

$$v = \frac{2*g*r^2(D_p-D_l)}{9*n}$$

v= settling velocity (cm/s)

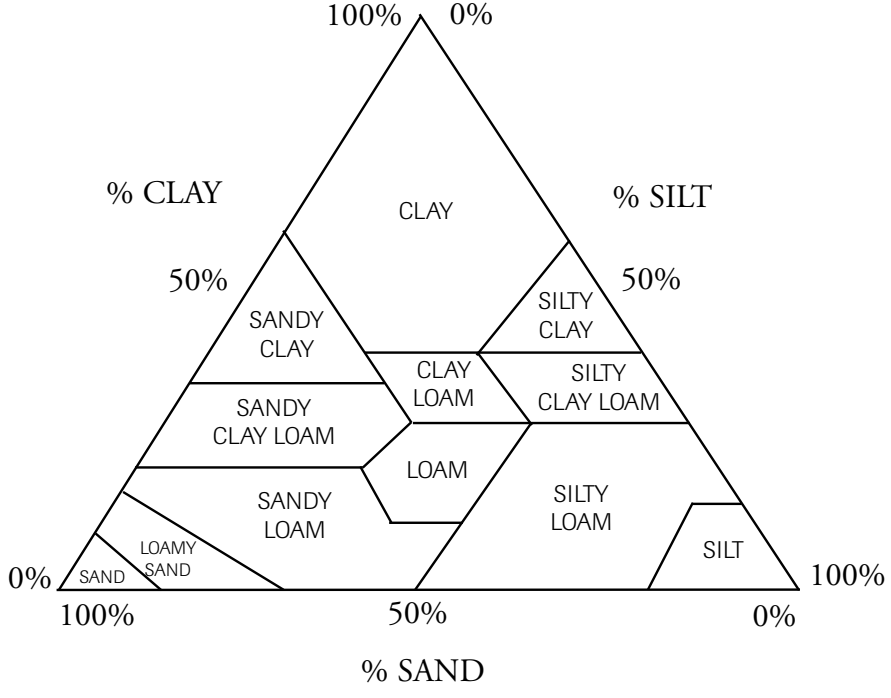
g = acceleration due to gravity (cm/s2)

r = particle radius (cm)

Dp = particle density (g/cm3)

Dl = liquid density (g/cm3)

n = liquid viscosity (g/cm s)



THE USDA BIENZ SOIL CHART

This equation is simplified to V = kd2, where d is the diameter of the soil particles, k is a constant based on the liquid properties, and g is 980 cm/s2. The density is assumed at 2.65 g/cm3.

The pipette method requires that a sample be pretreated, after which subsamples of a soil suspension at a given depth after a period of settling time are extracted. The larger particles pass the sampling depth and the smaller ones can then be sampled. Samples are dried and weighed, after which the percentage of the total soil in suspension is determined and calculated.

The 12 Basic Soil Textural Mixes

Clay. More than 40% clay, up to 40% silt, and up to 45% sand. Minute particles of aluminum and silica forming a layered crystal structure. Highly water retentive to the point of inhibiting good drainage. Not to be used in high concentrations.

Clay loam. 25-40% clay, 15-40% silt, and 20-45% sand.

Loam. 8-25% clay, 30-50% silt, and 25-50% sand. Even mix of fine clay particles, coarse sand particles, and organic materials. Best for cultivation

Loamy sand. 15% clay, 15-30% silt, and 70-90% sand.

Sand. 85-100% sand, up to 10% clay, and up to 15% silt. Mineral particles, mainly quartz. Coarse. Good drainage.

Sandy clay. 35-55% clay, 45-65% sand, and up to 20% silt.

Sandy clay loam. 20-35% clay, 45-80% sand, and up to 25% silt.

Sandy loam. 15-50% silt, 45-75% sand, and up to 20% clay.

Silt. 80-100% silt, up to 10% clay, and up to 15% sand. Fine mineral particles usually deposited as sediment in rivers and lakes.

Silty clay. 40-60% clay, 40-60% silt, and up to 20% sand.

Silty clay loam. 25-40% clay, 45-75% silt, and up to 20% sand.

Silty loam. 50-80% silt, up to 25% clay, and up to 30% sand.

It is unlikely that you are ever going to use the Stoke's Law mathematical formula or that you will use the pipette or other method to determine the composition of a soil, and so this is just a little illustrative background information for you. If you really need to know what's in soil, a soils lab is your best and most accurate option.

NUTRITION

Plants are food factories. They manufacture their own carbohydrates, fats, and proteins daily during the process of photosynthesis, and they use that food during the night, during a process called respiration, to manufacture new plant structures such as stems, leaves, and flowers. In their natural habitats, plants derive nutrients from soil, which is almost always just right for their growing needs. The soil is constantly replenished with animal and vegetable matter that decompose into the soil, providing a veritable feast for foliage.

Indoor houseplants sit in the limited amount of potting mix that their pots can hold, often in minimal lighting, their "soil" not naturally replenished with rich nutrients unless we add them. But, there are so many kinds of fertilizers! To understand what to use and when, here are some basics of plant nutrition.

Macronutrients (Essential Elements)

Macronutrients are required in substantial quantities for growth. They include carbon, hydrogen, and oxygen which are derived from water and carbon dioxide. The following are obtained from the soil and are included in fertilizers.

◆ **Nitrogen/Nitrates (N).** Essential for the formation of amino acids in the growth of leaves, roots, and stems. In its natural form, nitrogen occurs in the soil as a result of decomposition of dead plant or animal matter. Plants assimilate it as nitrates, a soluble form that makes this element readily available to the roots. If the fertilizer label says the nitrogen is in the ammonium form (e.g., ammonium sulfate), this means that the nitrogen will be released slowly, over a few weeks to

a few months. Organic nitrogen is available in the form of blood meal, isobutylidene diurea (IBDU), or urea.

◆ **Phosphorus/Phosphoric Acid/Phosphate (P).** Necessary for root development, for creating sugars from starches, and for cell division. Phosphorus balances out any excess nitrogen and is supplied to the plant as a phosphate, the form which is easily absorbed by the roots. Phosphorus is most effective when you apply it directly to the root area of a plant, as it does not reach its final destination as easily when applied otherwise. If you are planting a rooted cutting or seedling, you can apply a general fertilizer containing phosphorus or a "superphosphate" to the soil in the area where the roots will eventually grow.

◆ **Potassium/Potash (K).** Required for disease resistance, root formation, and the transportation of carbohydrate foods throughout the plant. Potash is the form in which it is supplied to plants. When there is too little potassium it usually happens with soils that are high in silica or peat. Like phosphorus, potassium is most effective when applied near the roots or where the roots will eventually grow.

◆ **Calcium.** Increases the rigidity of the plant's cell wall and is found at the growing tips of roots. It is easily leached from the soil, which results in an acid soil that must be corrected by adding lime (calcium) or calcium carbonate.

◆ **Iron.** Essential to the formation of chlorophyll, meaning it is required to maintain a plant's green color.

◆ **Magnesium.** Comprises the nucleus of every chlorophyll molecule in a plant. It is supplied to a plant in the form of a sulfate such as Epsom salts.

◆ **Sulphur.** Acts with nitrogen to make new protoplasm for plant cells. Some nitrogen and potassium fertilizers are applied as sulfates and so sulphur deficiency is not usually a problem. It is often applied in sulfate form to prevent yellowing.

Micronutrients (Trace Elements)

Micronutrients are required in smaller quantities. These include boron, cobalt, copper, manganese, molybdenum, and zinc. Manganese and zinc are believed to act as catalysts for the utilization of other nutrients. Some experts believe that other micronutrients are chlorine, silicon, sodium, and vanadium.

Selecting a Fertilizer

Most fertilizers consist of pretty much the same things. It is just a matter of choosing ones that meet the nutritional requirements of the particular indoor plants you are caring for in a form you like best. Fertilizers are labeled as organic or inorganic (chemical). Either is effective, but they are different.

◆ **Organic.** These offer a gentler approach to feeding. They are derived from the remains of once living organisms. They work a little more slowly at first and they release their nutrients over a longer period of time. They are safer in the long run because they are less likely to build up in the soil and cause damage to the roots, and they often improve the soil as well. On the down-side, organic fertilizers tend to be a bit more expensive than their inorganic counterparts. They also tend to smell a little unpleasant, which makes them less popular for use indoors.

◆ **Inorganic (chemical).** These provide a reliable source of minerals and have a higher percentage of nitrogen, potassium, and phosphorus. You can use a much smaller amount of inorganic fertilizer than the amount of organic that you would need to achieve the same end result. But you need to be very accurate when measuring and applying them so as not to overfertilize.

On the whole, you should purchase a fertilizer that is specifically for the kinds of plants you are maintaining. In general, you will want to use different fertilizers for different plants: green tropicals, orchids and other bloomers, and cacti and succulents. Fertilizers for most tropical houseplants range from 8-8-8 to 20-20-20, usually with equal parts of the three main macronutrients.

Chelated fertilizers are chemically bound to an agent that makes them non-ionized and water soluble, so that the nutrients are readily available to the plant. Time-release fertilizers release nutrients over a period of several months. Many potting mixes contain them.

Most subirrigation systems will eventually require a liquid fertilizer, and you may wish to consult with the manufacturer of the devices you use to see if they have a recommendation for one that works well with their products.

Whether you use fertilizer in the form of dry granules, powders, tablets, spikes, or liquids, is entirely up to you. However, unless you are maintaining plants in a greenhouse, you will probably want to pass on using foliar sprays.

Once you decide on a fertilizer, it is important that you use it properly. Always READ THE LABEL. Do not ever use more than the label recommends. Plants indoors do not need much fertilizer because it is difficult to thoroughly drench a plant sufficiently to leach out the fertilizers without rotting the roots in the process. It's far better to err towards underfeeding.

When to Fertilize

Indoor plants usually receive a lot less light than outdoor plants. Because of this, the plant is not manufacturing or using a lot of its own food. Therefore, if you add food, it may not even be used and may instead build up in the soil where it ultimately damages the roots. The need to fertilize indoors is not urgent. The issue is how to keep the plant well-fed but growing slowly.

In most cases, lightly fertilizing once or twice a year during the growing season (mid-March through mid-September) is more than sufficient. But, if the plants need or can withstand more frequent fertilization, you can safely fertilize once a month with a low grade

How To Read A Fertilizer Label

1. PRODUCT DESCRIPTION. May be a brand name such as "Ready Bloom" or "Liqua-Gro" or something more generic such as "Houseplant Food."

2. ANALYSIS, FORMULA, OR GRADE. These three numbers, such as 8-8-8, 9-3-6, 19-24-18, etc., describe the percentages of nitrogen, phosphate, and potash (in that order). Sometimes called the N-P-K Ratio, the relative amounts of nitrogen, phosphorus, and potassium in a compound fertilizer.

3. GUARANTEED ANALYSIS. This is the manufacturer's product warranty of the contents.

4. TOTAL NITROGEN (N). The percentage of nitrogen; corresponds to the first number in line 2. There will often be other lines under this one to identify the source of the nitrogen, e.g., urea nitrogen, ammoniacal nitrogen, etc.

5. AVAILABLE PHOSPHORIC ACID (P_2O_5). This line states the percentage of phosphoric acid and corresponds to the second number in line 2.

6. SOLUBLE POTASH (K_2O). The percentage of soluble potash; corresponds to the third number in line 2.

SAMPLE LABEL

1. LIQUA-BLOOM
2. 20-24-18
3. GUARANTEED ANALYSIS
4. Total Nitrogen (N) 20%
   - 5% Ammoniacal Nitrogen
   - 5% Nitrate Nitrogen
   - 10% Urea Nitrogen
5. Available Phosphoric Acid (P_2O_5) 24%
6. Soluble Potash (K_2O) 18%
7. Boron (B) 0.02%

Copper (Cu) 0.05%	0.05% Chelated
Iron (Fe) 0.10%	0.10% Chelated
Manganese (Mn) 0.05%	0.05% Chelated
Zinc (Zn) 0.05%	0.05% Chelated

8. Primary nutrients from Urea, Ammonium Phosphate and Potassium Nitrate. Micronutrients from Boric Oxide, Iron, Copper, Manganese and Zinc.

7. SECONDARY & MICRONUTRIENTS. When present these nutrients are listed along with their percentages. These may be present and still not be listed, but if they are listed it means they are guaranteed to be there by the manufacturer.

8. DERIVATIVES. This last line usually identifies the source of the nutrients if not stated previously.

fertilizer during the growing season. Do not fertilize when a plant is dormant (fall and winter). This can cause plant damage or death.

Hold back on fertilizing plants that are rootbound or that dry out between visits. Transplant or replace soil on these plants first so that they can retain moisture properly. If you fertilize a plant that dries out quickly between waterings, the nutrients will end up burning the roots and damaging or killing the plant.

Symptoms of Nutrient Deficiencies

Most macronutrient deficiencies can be treated with proper fertilization. Micronutrient deficiencies can be treated with mineral supplements.

Boron. Brittle, pale new leaves. Raised areas on undersides of veins and along petioles turn black and ooze a gummy substance. Stunted vertical growth. Increased lateral breadth as terminal buds die.

Calcium. Affects growing tips, crinkles leaf margins, and stunts roots. Leaves may turn brown and abscise (fall off).

Copper. New leaves chlorotic with brownish margins and wilt.

Iron. Interveinal chlorosis, mainly in newer growth. Leaves may turn yellow or white. (May occur in alkaline soil, which makes iron unavailable.)

Magnesium. Chlorosis, necrosis, stunted growth. Puckering and whitening of leaves. Older leaves affected first, yellowing at margins.

Manganese. Dwarfism, mottling, and interveinal chlorosis of newer leaves, usually in checked or striped pattern.

Nitrogen. Stunting. Chlorosis or yellowing, later browning, of older leaves.

Phosphorus. Rare. Poor root growth. Brownish-purpling of older leaves. Leaves in general may be abnormally dark green.

Potassium. Yellow tips and edges of older leaves. Stunted growth. Leaf loss. Occurs mostly in siliceous or peaty soils.

Zinc. Mottling of leaves. Dwarfed and chlorotic new growth.

Applying Fertilizer

When applying fertilizers, always apply them to moist soil, even if you are applying a liquid or powder fertilizer that you have just mixed with water. Do not let any of the substance get on the stems of the plants as the chemicals in the fertilizer can cause damage to the plant tissues. Apply the fertilizer evenly over the entire soil surface so that it will reach down into the entire root system of the plant and not just into one area. Try to remember that a plant's root system can very well be spread throughout the entire soil area of the container.

Overfertilization

When plants are overfertilized there is resulting damage to the roots, which does not become visible throughout the rest of the plant until well after the damage is done. The roots may even die if the level of soluble salts (minerals) is excessively high. Common symptoms of overfertilization or fertilizer "burns" include chlorosis, wilting, and necrosis of the leaf margins and tips. But there are exceptions. For example, too much nitrogen results in soft plant tissues which are high in water content and therefore more prone to damage by cold temperatures (freezing). Also, excess nitrogen can induce a potassium deficiency.