Fertilizer Numbers

By Bob

What do numbers mean to Bonsai growers? The most popular and often repeated numbers that you may have heard at a Bonsai meeting or among members talking amongst themselves are likely 20-20-20 a fertilizer ratio. But what does this number really mean? They specifically refer to the ratios of the '"***Primary"*** components in fertilizer mixtures.

Let's take some time to understand the importance of those numbers. I just went and found the following label for a foliar fertilizer. This is what was listed on the main portion of the label, but under the heading **20-20-20** the following information also appeared.

"Guaranteed Minimum Analysis"
Total Nitrogen…….20%
Available Phosphoric Acid (P2 O5) ……...20%
Soluble Potash (K2 O5)……...20%
EDTA Chelating Agent…….1%

Micronutrient Content - Actual
Chelated Micronutrients
Iron (Fe)…… .01%
Manganese (Mn) ……... 0.05%
Zinc (Zn)……0.05%
Copper (Cu)…… 0.05%

What does all this jargon stand for? Well, most of you don't likely care beyond maybe the first three main or *Primary* numbers. More important why choose to use say 20-20-20 over maybe15-30-15, 10-30-20 or 15-15-30 or some other combinations?

Well first let us understand what the first three nutrients on the label do in regard to your plants' response

Various nutrient components have a wide range of mobility within the soil and within the plants themselves. It helps to know this when you are fertilizing.

Fertilizer components are classified by four distinct groups N-P-K. These are known as ***Primary***. The ***Secondary*** nutrient classification represents Ca, Mg and-S. The third group is composed of ***Micronutrients*** and more recently growth hormones. To some extent these three classifications represent the quantities of each class by the plants' use requirements. However, because one class is designated secondary or as a micronutrient, it does not mean that the plants need for these elements is any less than the primary nutrients. It only means that the quantities required for optimum healthy growth and development is much less, but they are still an essential requirement for balanced healthy growth.

Mobility of Nutrients in Soil and Plants

	Mobility in Soil	Mobility in Plant
Macronutrients		
nitrogen	med-high	high
phosphorus	low	high
potassium	low-med.	high
Secondary Nutrients		
calcium	low	low
magnesium	low	high
sulphur	medium	low-med
Micronutrients		
boron	high	low-med
copper	low	low
iron	low	low
manganese	low	low
molybdenum	low-med	med-high
zinc	low	low

The role of various nutrients:-

Primary Nutrients:

Nitrogen is involved in many plant processes and structures. Compared to other nutrients it is required in large amounts. Growth is one of the main functions of nitrogen. Nitrogen is a very mobile nutrient within the plant. It is required when the plants are growing actively.

Phosphorus less than 5% of a soil's phosphorus is available or slowly available to plants at any time. Phosphorus is very immobile. Like nitrogen, phosphorus is an important factor in many plants' metabolic processes. A couple of significant roles to bonsai growers are cell division and enlargement, photosynthesis and respiration. The effect of the availability and supply of phosphorus on these plant processes is reflected in particular on root development. Roots tend to proliferate in the soil when an adequate supply of phosphorus is available. When phosphorus supplies are adequate, the increased energy and carbohydrate metabolism results in better winter survival.

Potassium: Soil minerals are rich in potassium although little is available to the plant. Ninety to 98% of the soil's potassium is tied up. Plants need potassium in about the same amount as nitrogen. Potassium influences the uptake of water by the roots - it also plays a role in stalk strength and aids in insect resistance.

Secondary Nutrients:

Calcium:

Calcium is important in the stabilization of the cell wall and is involved in the metabolism and formation of a cell nucleus. Calcium deficiency is usually not of concern to bonsai growers.

Magnesium:

The availability of magnesium is influenced by several other nutrients Potassium, if present at high levels can interfere with magnesium uptake. Some research suggests that magnesium encourages the uptake of phosphorus. Magnesium has several roles in plant growth and development. Like calcium, magnesium deficiencies are linked to soil pH, course textured, acidic soils are more likely to develop a magnesium deficiency. Since magnesium plays a role in chlorophyll production, deficiency symptom may be visual in the form of as a crimson colour and/or as dead tissue between the leaves veins, or a pale green colour caused by low chlorophyll content.

Sulphur:

The most important role of sulphur for bonsai growers is in stabilizing or increasing soil acidity in those plants grown best under acidic conditions such as azaleas and rhododendrons though acidity can also be altered by using organic materials like pine needles, oak leaves etc.

Micronutrients

Zinc:

Zinc is relatively immobile in the soil. So that leaching does not pose a problem. Zinc availability is reduced by high **pH**. Zinc is important in early plant growth and in grain and seed formation. It plays a role in chlorophyll and carbohydrate production. Zinc deficiencies are most often seen on high **pH** soils. These most often appear as chlorosis of young leaves, a green halo appears, along serrated margins of young immature leaf blades. Other symptoms may include blind bud, little leaf and rosetting (small basal leaves forming on short terminals and lateral shoots of the new year's growth).

Manganese:

Soils contain large amounts of manganese but little is available. The availability of manganese is influenced by **pH** as values rise, exchangeable manganese declines rapidly. Availability is greatest between **pH** 5.0 t0 6.5

Manganese is involved in photosynthesis and chlorophyll production. It helps activate enzymes involved in the distribution of growth regulators within the plant.

Manganese deficiency most often appears as a chlorotic condition in younger leaves. Veins of the leaves will remain dark green while between the veins the tissue will go yellow. *Manganese deficiencies often appear in some Bonsai because of the frequent watering these plants require.*

Boron:

Boron in the soil is present as soil solution boron, absorbed boron and mineral boron. Boron uptake by plants is related to **pH**. Availability is best at **pH**'s between 5.0 and 7.0.

Boron plays an important role in the structural integrity of cell walls, fruit set and seed development and carbohydrate and protein metabolism.

Symptoms of boron deficiency vary widely. They may show up as dead terminal buds, dwarfed stiff cupped and brittle leaves, and blossom blast.

Copper:

Copper availability is influenced by soil texture. Copper levels are lower in sands, Copper mobility increases as soil **pH** rises, and its availability is extremely low in high organic soils.

Copper plays a role in chlorophyll production as a catalyst for enzymes, and in disease suppression.(However copper is not likely to be of major concern in bonsai plants.

Iron:

Iron is abundant in most soils but its solubility is very low. Iron plays a number of functions within plants. It is a catalyst in the formation of chlorophyll. It is required for plant respiration and functions in the formation of some proteins. Iron deficiencies are seldom found however because rhododendrons perform best in acid soils they *might* on occasion require some iron.

Some fertilizer products also contain plant growth regulators these organic compounds, either natural or synthetic, modify or control one ore more specific, physiological processes within the plant. If the compound is produced within the plant it is called a plant hormone, e.g., auxin, which regulates the growth of longitudinal cells involved in the bending of the stem one way or another.in phototropic response. The natural sources are formed in small amounts in the green tips of growing plants and in the root tips. Indoleacetic acid is the most important natural source. It is the component used in *"Root Stimulant"* products applied externally when making and planting cuttings to bring about the improved rooting of such cuttings.

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*Gibberellins:*This group of plant growth regulators help promote cell elongation in plant shoots and some fruit.

Cytokininins:

This particular group of hormone promotes cell division and differentiation often recommended to stimulate root development. It is the component in most *root stimulant* products. One of the sources of Cytokinnins is sea weed and kelp however product obtained from this source is often very irregular in analysis and thus its results will vary, therefore a pharmaceutical grade will give more dependable results.

Now to the Basics

Bonsai need to be fertilized frequently because the soil mixture used in their potting can't hold on to nutrients the way potting soil can. During the growing season (spring and summer) they may be fertilized once or twice a month at full strength, though it is preferable to fertilize more often at ½ strength or even weaker. Liken your bonsai to a baby, spoon feed it with low strength material frequently. Do not feed those plants which are going into winter storage after Labour Day as this will produce soft new tissue which is not hardy enough to overwinter under our conditions.
Indoor (tropical varieties) - Once they have been brought indoors and should be first fed after they have become acclimatized using a ½ strength mixture of the appropriate blend, they can be fed monthly at this diminished strength.

*Remember that **N** is for growth, **P** is for root production and flowers, while **K** is for energy storage, stalk strength and helps in water uptake.*

Evergreens such as Junipers, Larch and Pines should be fertilized with 30-10-10

Deciduous such as Maple, Ginko, Ficus, and Hornbeam should be fertilized with 20-20-20

Flowering or Fruiting Varieties such as Pomegranate, Quince, Potentilla and Bougainvillea respond best to a 15-30-15.mixture.

General:
Potting or transplanting after the initial transplanting shock and before moving your newly potted plants out into display areas they should be fed according to directions with 10-52-10 or 5-15-5 starter fertilizer along with **B1** to stimulate root development. Never fertilize a tree when it is dry first moisten the soil then fertilize. Never fertilize a tree that is unhealthy as this would increase the stress to the tree and may damage the roots and therefore harm the tree.

One method of fertilizing your trees is to put a dilute solution of the appropriate mixture in a tub of water and plunge your trees either down to the level of the top of the pot or under the soil surface (depending on the consistency of the surface soil). When bubbles cease coming from the pot, remove, placing the plant on a slant ensuring therefore that the plant drains thoroughly.

Granular vs. Soluble and Liquid Fertilizers:
Fertilizers are generally available in three forms, Granular which is applied as is in recommended quantities and soluble powders which must be added to water according to directions as well as pure liquids which must also be added to water.
Granular products are usually a mixture of the different components which have been blended to meet the label requirements, although the use of blended mixes is not frequently used by bonsai growers because these blends may segregate which is not a problem when spread over a wide area but could prove detrimental when used on the soil surface of a single pot. The granular type most frequently utilized, is a more expensive one that is composed of a homogenous blend of the components which is pelletized and often coated with a slow release coating. The advantage of this type is that each pellet contains virtually the same blend of components and that their release occurs over a longer period of time. You will often see this product as little round pellets distributed on the surface of commercially purchased trees. The problem with granulars as a source is that they are not chelated which means that they can quickly get tied up within the soil complex and only be available over a long time (sometimes over several years).

Soluble fertilizers are by the far the most frequently used sources of bonsai fertilizer. While handy they are much more expensive than granular products. They, however, often contain chelated micronutrients which means the metal ions are not tied up immediately. They may be sprayed on the plants (as they are readily absorbed) added to the water for surface watering or added to the water for soaking the trees in their pots. One disadvantage is that the manufacturing process only allows less than 1% of all the combined micronutrients to be included (look at the above label for 20-20-20 and you will see that total micronutrient content is 0.16% of the formula). Liquids, while more difficult to obtain and even more expensive, are used at very low rates and chelated micronutrients often can be between 5-7%. In addition, many contain growth hormones as well. They may be applied in the same manner as soluables.

Visual Symptoms of Nutrient Deficiencies In Ornamentals

Nitrogen deficiency St. Johnswort

Potassium deficiency Azalea

Boron deficiency Philodendron

Calcium deficiency Viburnum

Copper deficiency Azalea

Iron deficiency Amur Maple

Magnesium deficiency Mock Orange

Manganese deficiency Gardenia

Zinc deficiency Pear