

## The A-B-Cs of Fertilizers: The N-P-K of Plant Growth by Russell Kinerson

### Part 1: Early Beginnings

Before the days of artificial fertilizers, there was an ancient principle embodied in all farm lease agreements. The rules of good husbandry decreed that there were certain things the tenant might not take off the farm; the hay and the straw had to be fed to the animals and their manure put back on the land. If they were carted off and sold, the land suffered. No one knew that essential potassium went with them. No one knew about potassium at all. By the early nineteenth century, chemists were able to analyze plants and discovered that the plants consisted of at least eight elements. They could account for the carbon, hydrogen, and oxygen as coming from the water and carbon dioxide in the air. But that left nitrogen, phosphorus, potassium, calcium, and magnesium, which they deduced, must come from the soil. Manure, they discovered, also contains these elements. Therefore, they concluded, these were what the old farming practice had unwittingly been recycling.

Manure, however, contains very little of the essentials in proportion to its bulk, only thirty pounds of all these elements together in a ton. And so, they reasoned it would be much more efficient to apply the elements directly. Nitrogen was the first ele-

ment to be a practical proposition for direct application to the land. It was easily available either in the form of ammonia sulfate, a by-product of burning coal to produce gas, or as nitrate of soda, which was discovered to exist in vast quantities underground in Chile. Either of these spread on the soil in Spring had the immediate effect of promoting lush, green growth. Unfortunately, they were also leached out of the soil by rain, so they needed to be applied in small amounts and often.

The next chemical to be found in a usable form was phosphorus. A young English squire, John Bennet Laws, of Rothamsted in Hertfordshire, became interested in why ground-up bones improved the fertility of some soils but not others. He dissolved some bones in sulfuric acid and found that the answer was simple: bone "meal" provided phosphorus (which is essential for good root growth) in acid soils that could dissolve it, but remained insoluble in alkaline soils. His invention of "superphosphate" made him a fortune and founded the artificial fertilizer industry. He did not have to dig up the battlefields of Europe (as some of his enemies claimed) to find enough bones. He used natural deposits of calcium phosphate.

Nitrogen is all around us in the air. It should, the chemists thought, be reasonably easy to combine it with the hydrogen in the air to make ammonia. This, in turn, could easily be made into plant food by oxidation into its sulfate or nitrate. They found that a powerful charge of electricity could do the trick. In fact, lightning does it regularly; the rain in a thunderstorm is very dilute nitric acid. By World War I, German chemists had found a catalyst which made it a simple industrial process, to the great consternation of the British. Nitrates are a prerequisite for high explosives, and Britain still had to import hers from Chile. But that's another story.

Potassium has long been applied to the soil in the form of fresh ashes from wood fires, which contain about

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## PRESIDENT'S MESSAGE by Joe Gutierrez

We are now in the midst of Winter, and thankfully, we have not had the tremendous amount of snowfall so far that we experienced last year. The deep snows of last Winter had the beneficial effect of keeping root temperatures for my outdoor bonsai right around the 32 degree mark. This was good insulation for the roots. The downside of the heavy snowfall, however, was that the deer in my back yard and in the adjoining parkland had difficulty finding anything to graze on. Therefore, they feasted on the tops of the bonsai since these were the only things sticking up out of the snow. Unfortunately, deer pruning is less than masterful. To further compound things, as the snow started to melt away, the deer started to rub their antlers on some of my taller trees, finding that they were perfectly handy for rubbing some of the velvet off their antlers. Thus, the problems that the deer created were really secondary to the problems the weather conditions created for the deer. The challenge now is to do some restyling on certain trees. Such are some of the challenges we face in bonsai.

Now is the time to start cleaning your tools, preparing soil mixes, planning styling for your trees, as well as preparing your trees for the springtime (which will not be too far away). Pick out the trees that you want to prepare for our Spring shows and also draw up your list for the various materials, tools, wire, etc., that you will need for the coming repotting and rewiring season.

To all our various clubs, please start considering members to nominate for our next election which will be upcoming at our annual meeting in April.

Plans are also being formulated for the Spring Show as well as for our Fall Symposium. It is time to renew membership so you continue to receive your copies of our PBA Clippings. As soon as the programs are finalized, announcements will appear in the pages of this newsletter.

For those of you who enjoy Winter and winter sports, enjoy what is left of Winter. For those of you who are pining for the first breath of Spring, that is not too far away.

## Editorial by Jules Koetsch

As I understand what was relayed to me recently by others, the new curator of the National Bonsai and Penjing Museum, Warren Hill, has some very interesting ideas on the care and feeding of bonsai. I'm writing this to meet the deadline of the February issue of PBA Clippings. "Deadline" is something Beth, Judy, Betty and I (some of us do better than others) try to meet so that the Febru-

ary issue won't arrive in the mid-February mail or later. Therefore, you'll have to wait for the next issue of PBA Clippings when I may be able to pass along what Warren Hill lectured on at the January 16th meeting of the Brookside Bonsai Society.

What has been relayed to me are three areas of interest to all bonsai growers which have been addressed by Warren Hill:

Continued on page 4

Meeting location and club contact number for additional information is as listed unless otherwise noted in calendar listing. A member of any one club is eligible to participate in any PBA or PBA member club event.

### BALTIMORE BONSAI CLUB

Cylburn Arboretum, Baltimore, MD.  
3rd Sunday, 1 PM  
(410) 668-1868

### BOWIE BONSAI CLUB

Bowie Community Center, Bowie, MD  
Last Monday, 7 PM  
(301) 350-3586  
(202) 667-1016

### BROOKSIDE BONSAI SOCIETY

North Chevy Chase Recreation Center, Chevy Chase, MD  
3rd Thursday, 7:30 PM  
(301) 365-7621

### CHESAPEAKE BONSAI SOCIETY

Call for meeting time and location  
(410) 263-2748

### GREATER PHILADELPHIA BONSAI SOCIETY

Pennypack Watershed, Willow Grove, PA  
4th Thursday, eve.  
(215) 663-1678

### KIYOMIZU BONSAI CLUB

Clearwater Nature Center, Clinton, MD  
4th Sunday, 2 PM  
(301) 839-2471

### LANCASTER BONSAI SOCIETY

Manheim Twp. Park, Stauffer Mansion Lancaster, PA  
2nd Thursday, 7 PM  
(717) 872-5941

### MEI-HWA PENJING SOCIETY

(Chinese language spoken)  
Bowie Community Center, Bowie, MD  
2nd Sunday, 1 PM  
(301) 390-6687

### NORTHERN VIRGINIA BONSAI SOCIETY

Greenspring Horticultural Center, Annandale, VA  
2nd Saturday, 10 AM  
(703) 575-5616

### RAPPAHANOCK BONSAI SOCIETY

Call for meeting time and location  
(540) 775-4912

### RICHMOND BONSAI SOCIETY

Imperial Plaza, 1717 Bellevue Ave., Richmond, VA  
4th Monday, 7 PM  
(804) 527-4000 Ext. 4621

### WASHINGTON BONSAI CLUB

U. S. National Arboretum, Washington, D.C.  
3rd Saturday, 2 PM  
(202) 543-7433

Organizations sponsoring regular events of interest to PBA members:

**U.S. Botanical Gardens**  
(202) 226-4082

**U.S. National Arboretum**  
(202) 245-2726

## February

Thursday 06  
Greater Philadelphia Bonsai Society  
Discussion on Pines  
Pennypack Watershed, Willow Grove, PA

Saturday 08  
Northern Virginia Bonsai Society  
9 am - 10 am Pot Care- Chris Yeapanis  
10 am - 12 pm Collecting Native Materials- Joe Gutierrez

Thursday 20  
Brookside Bonsai Society  
7 pm Peter Jones, Grafting.  
North Chevy Chase Recreation Center

Saturday 22  
Brookside Bonsai Society  
9:30 am - 12 pm Peter Jones, Grafting workshop to be held at Shari Sharafi's house.

Monday 24  
Richmond Bonsai Society  
7 pm Bruce Stoneman, Demo with Japanese Maple. Imperial Plaza

## March

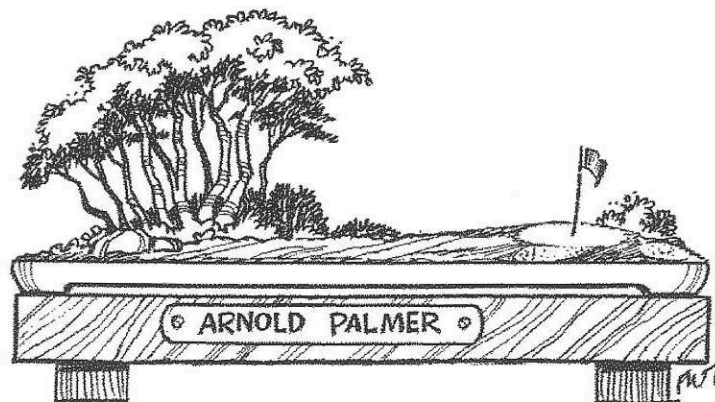
Saturday 01  
Richmond Bonsai Society  
9:30 - 11:30 Crab Apple/ Japanese Hornbeam Workshop (\$28)  
Imperial Plaza. Contact club for availability and details.  
12:30- 3:30 Japanese Mountain Maple Workshop (\$42)  
Imperial Plaza. Contact club for availability and details.

Saturday 08  
Northern Virginia Bonsai Society  
9 am - 10 am Pines, Bring your own trees for discussion and critique - Peter Jones  
10 am - 12 pm Wisteria Bonsai - Hi Ping Shelly  
12 pm - 4 pm Chinese Privet Workshop - Hi Ping Shelly.

Saturday 22  
Richmond Bonsai Society  
9:30 - 11:30 Japanese White Pine Workshop (\$37)  
Imperial Plaza. Contact club for availability and details.

Please submit your club's new schedule as soon as available to Doug French at [Dfrench200.aol.com](mailto:Dfrench200.aol.com) or (703) 502 - 9426. Thank you for your cooperation.

## CELEBRITY BONSAI BENCH



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## Editorial, continued from page 2

1. Fertilizing - Using inorganic fertilizers like Miracle-Gro will, among other things, raise the level of salts in the soil and for that reason should not be used.

2. Soils- Turface is not the best soil ingredient considering what else could be used.

3. Disease - When pruning, sterilize the pruning tools with alcohol - maybe not with every cut but at least once when going from tree to tree to prevent any disease from being transmitted to another plant.

Considering the above three items, it appears that the Brookside club meeting should be a very interesting and lively one.

As for fertilizers, I've used, in combination, fertilizer balls (organic) and liquid inorganic fertilizers. Some Japanese bonsai growers in the past claimed that we Americans water too much and fertilize too little. In response to that, one prominent American bonsai grower decided to use fertilizer balls and also once a week apply a full-strength solution of a liquid inorganic fertilizer and reported no ill effects. Then again, there's the idea of applying liquid fertilizer in weak amounts with every watering. It seems that a point of concern is the amount of salts formed which may

remain in the bonsai pot. Trying to get a handle on the subject of salts in soil, I read pertinent sections in the Yearbook of the U.S. Department of Agriculture 1957 SOIL." One can say that with its 1957 date, it's probably out-of-date in some of its content.

Reading various sections pertaining to salts in the Yearbook, I came up with the only thing that I could understand - the definition of what a "salt" is. Both the Yearbook and the 1990 "Random House Webster's College Dictionary" define "salt" as the product of the reaction of an acid with a base. So you see that a salt can be other than the familiar table salt (NaCl - sodium chloride). The Yearbook also defines a salt as a chemical compound formed when the hydrogen of an acid has been replaced by a metal. After that, everything in the 1957 book becomes very involved, which left me with the only thought voiced by others in the past - salts in a bonsai pot are never any problem - frequent watering washes out the interlopers. Is that, or is that not the reason for worrying about salts?

Salts are supposed to inhibit plant growth. In the Dec. 10, 1996 Science Times section of the N.Y. Times,

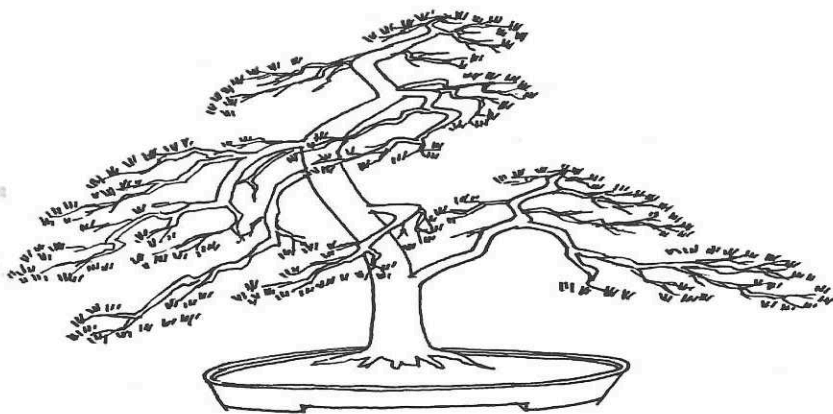
an article appeared with the title "Too Much of a Good Thing Makes Benign Nitrogen a Triple Threat."

Does too much nitrogen (when fixed with other elements and not absorbed by the roots but left in the soil) allow the residue to feed fungi and harmful bacteria? Note that nitrogen alone cannot be absorbed by the roots. It must be fixed with another element to be absorbed. That's another thing I learned reading the 1957 book. The nitrogen gas in the atmosphere will not do it. Wouldn't you know something like the above would come up just when I had settled during last year on using the liquid product, Dyna-Gro, to feed my bonsai.

As for soils, I admit that over time, Turface has a tendency to decompose, but it's locally available.

As for disease - I should be more diligent in keeping my pruning tools clean.

Seeing that the local meteorologists missed their forecasts of bad weather for the Thursday meeting night, I'm all set to go and make copious notes. It looks like Warren Hill's tenure as Curator of the National Bonsai and Penjing Collection is starting out to be an exciting one.



## February Monthly Care Tips

Just a little over a month and we'll be scrambling to get the bonsai out of Winter storage and in place for their Spring-Fall sojourn.

Watering and pruning tips from January still apply.

Ginkgo - good month to prune branches.

Start a log. Make a list of trees to be repotted and when.

Check soil supply and mix batches as appropriate.

Time to think about fertilizers. If you like the idea of using paste or fertilizer balls, now's the time to get the bloodmeal, cottonseed meal, and

bonemeal. John Naka's recommended mix in his book, "Bonsai Techniques," is a good one to follow: 1 part bloodmeal to 2 parts cottonseed meal. One part bonemeal can be added for the flowering bonsai. The bonemeal is the component that makes the balls reek until they dry. Hence, Winter is a good time to do this (so that when they're drying outdoors the odor akin to s—t is not causing neighbors to openly rebel against you). They can be placed in the cups of an egg carton for approximately two weeks to dry. Users should remove and replace the

balls after one month so they do not decompose and cause root rot. The nutrients in the balls are usually pretty well exhausted by one month's time. Fresh fertilizer made the same size as the dried balls can be placed on the surface of the bonsai pots, but understand you have to fight the odor - that is, if you've added bonemeal. I like to use the dried balls, but it's a matter of finding the time for the process, and then there's the problem of getting them to stick together. You are on your own here- -some success has been had using beaten egg white or Elmer's glue as a binder.

### Invitation to Ikebana Exhibition - A Sister Art

Editor's note: Ikebana has the same principles of styling and composition found in bonsai. To hone your skills in bonsai, you might consider taking up ikebana or maybe get your spouse to do it. In Japan, it had been the custom for the men to do bonsai and the women, ikebana. It should be a very enjoyable exhibition. John Y. Naka has said that when styling his bonsai he has always received good suggestions from his wife Alice, who does ikebana.

Janet Sexton-Borgiotti, President of the Ohara School of Japanese Flower Arrangement,  
has cordially invited us to view their efforts.

An exhibition will be held on March 22 and 23, 1997,  
at the American Horticultural Society River Farm.

**The featured guest arranger will be  
Grand Master Mutsuo Tomita, Director, Ohara Center of New York,  
an internationally renowned artist of extraordinary talent.**

The address of the AHS is 7931 E. Blvd. Drive, Alexandria, Va.

The hours on:

Saturday, March 22, will be from 1:00 - 4:00 p.m.;

and Sunday, March 23, from 12:00-4:00 p.m.

**Admission is free with ample parking.**

## Ancient Celtic Tree Horoscope by Jules Koetsch (Continued from January)

Last month's PBA Clippings (January 1997) contained a write-up on the Celtic tree horoscope; and horoscopes were given for those born in the month of January up to and including February 3. It so happens that the Celtic tree signs, except for the Poplar sign, appear again covering a 10-day period about onehalf a year later. Hence, last month's horoscopes also covered June 25 through August 4. This issue's horoscopes are for the February birthdays between August 5 and 13. Since the Poplar tree sign appears 3 times, May 1-14 is also covered.

**POPLAR** (Feb. 4 8, May 1 14, and Aug. 5 13)

1986 - The poplar person appears never to recognize old age. But your appealing exterior stands in strange contrast to your uncertain behavior. Frequently, life's circumstances weigh heavily on your shoulders; and to be happy and contented, you require much good will and pleasant surroundings. You are often very fastidious, often remain solitary and alone, and you do not always find fulfillment of your heart's desires. Your enormous sensitivity

causes you to seek isolation or find artistic endeavors as a form of self-expression. You take partnerships very seriously. You are reliable, and your independent nature shows through love as soft and dependent. Your outstanding talent for organization can make your family and professional life much easier. 1997 - Poplar is a Celtic tree sign that appears three times in the Celtic tree horoscope so that the 10-day periods assigned twice to each of the other tree symbols, along with the three periods of time assigned to the Poplar tree symbol, add up to the 365 days of the year. In all three time frames, poplar people, through their cosmic energy, provide fresh approaches to anything in the development stages. They mentally store up all experiences, along with colorful impressions. It is also not astonishing that they pass on their enthusiasm to all, whether or not it is of any concern to anyone else. Ongoing efforts consist of safeguarding possessions and aspirations, and also to manage valued property. There with the essential precepts are to exercise calm and caution, followed by the use

of strength and energy. There is a consistent equanimity in each of the three time frames those born in February have a meticulously calculated behavior, those born in the August time frame have a sympathetic candor, and the May people have both characteristics. In matters of love, the poplar person can be extremely sentimental. They are happily ordained to have a talent for creating enjoyment, and thereby are strongly attractive to the opposite sex. Their immense love for music and nature are frequently means to an end. The August people have a supplementary characteristic a liking for everything including luxuries.

**CEDAR** (Feb 9 - 18 and Aug 14 - 23)

1986 - The cedar person is one of rare, thoroughbred beauty. You have an excellent understanding of that so as you go through life you are confident and resolute, sometimes indeed impatient and irritable; and you always like to impress your fellow man. The cedar person possesses managerial qualities and can hit on hasty decisions. In addition to those attributes, the cedar person is indus-

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## John Naka's Last Convention and You all are invited

I believe this will be my final demonstration of my career for any bonsai convention. My old age creeping up on me and I am really not able to do anything anymore. However, I am very fortunate that I will have many, many students who will assist me.

This 40th Anniversary Bonsai Convention for the California Bonsai Society will feature many artistic

talents of the CBS members. Home made cooking will be served to you all, no outside cooking involved in this. We are expecting a super bonsai convention, hope you will all come and join the celebration.

Sincerely Yours  
John Naka

PS: I want to thank you for sending me your News Letter or Magazine to me. Since I am not able to attend your shows you can not imagine how much I enjoy and appreciate reading all about your activities, keep them coming.

**Announcing  
a fun-filled  
5-day  
schedule:**



**ANNIVERSARY CONVENTION**

**CALIFORNIA BONSAI SOCIETY**

**BONSAI: TREASURES OF THE  
HEART**

**MARCH 19 - 23**

**15 Spectacular Workshops  
3 Exciting round Robin demos  
a unique 2-part, 5-way "competition"  
demonstration  
plus a California juniper dig**

**...and, an extra-special 2-part demonstra-  
tion  
by the one-and-only John Y. Naka**

All this, and a private premier night reception for the annual CBS Masterpiece Bonsai Exhibition at the Huntington Botanical Gardens, hugh bonsai bazaar, benefit drawings, banquets and more.

**Featuring the artistic talents of CBS  
members:**

Marybel Balendonck, Jim Barrett, Susanne Barrymore, Marge Blasingame, Pat Brodie, Frank Goya, Frank Haraguchi, Warren Hill, Harry Hirao, Yeako Hisayasu, Mel Ikeda, Mas Ishii, Glen Jensen, Bob Kinoshita, Erni Kuo, Leila, Kusumi, Cheryl Manning, Ted Matson, Shig Miya, Mas Moriguchi, Ed Muraka, Sam Nakano, Ben Oki, Richard Ota, Larry Ragle, Lindsay Shiba, Hank Sugimoto, Melba Tucker, Kaz Yoneda.

**For registration information, contact:**



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CHAIRPERSON  
14396 Harvest Crescent  
Poway, CA 92064  
Phone: (619) 486-4805  
Fax: (619) 486-5620

PASADENA HILTON  
150 So. Los Robles  
Pasadena, CA 91101  
Reservations: 8-(818) 577-1000

## Fertilizer, continued from page 1

ten percent of potassium carbonate or potash. Its value to plants lies chiefly in speeding the production of sugar in the leaves, and thus speeding the ripening process, the filling-out of beets and potatoes, the sweetening of fruit, the stiffening of grass stalks, and the turning of new wood from green to brown.

The need for industrialized production of potassium fertilizers came as farmers abandoned their old recycling methods and turned to direct applications. Rock deposits known as kainite, which overlaid deposits of common salt in Germany and Austria, were found to be a mixture of potassium sulfate and magnesium sulfate. Of the other major elements, calcium was easily come by and indeed had been used for improving heavy clay soils since Roman times. Chalk or lime, or marl, has the property of binding the clay particles together and making them more workable. It is only a very acid soil that normally lacks enough calcium for most plants' chemical needs. Magnesium, on the other hand, is often in short supply. Its function in plants is the manufacture of chlorophyll. Where magnesium is lacking, leaves are pale or sometimes flushed with purple. An excess of potassium and a shortage of nitrogen are often the indirect cause. A simple remedy to correct magnesium deficiency is a dose of Epsom salts. Just mix up a teaspoon in a quart of water and spray on the foliage.

Since the early experimental days, additional elements have been found to be essential to plants, but these are only needed in small quantities. These 'trace' elements are

magnesium, iron, manganese, boron, copper, zinc, molybdenum, calcium, sulfur, and chlorine.

Much research has gone on with agricultural crops in an attempt to determine the most favorable proportions for the various species. Few similar investigations have been conducted with forest trees and so there are no prescriptions for the different proportions of NPK to be used with our bonsai.

### Part II: Soil as a Nutrient Source

For most gardeners and farmers, it is only the first three nutrient elements: nitrogen, phosphorus and potassium (N,P,K) which regularly need to be added to the soil, and then only when crops are being taken from the ground and not returned to it. However, when using a bonsai soil consisting typically of pine bark, baked clay, and crushed granite, there is a need for frequent and complete nutrient applications which include all of the essential elements.

All fertilizers have a three-number notation. It refers to the percentages of nitrogen, phosphorus, and potassium compounds respectively in the fertilizer. For instance, 5-10-5 is 5% nitrogen (in the form of ammoniacal nitrogen, nitrate nitrogen, or urea,  $\text{NH}_4^+$ ,  $\text{NO}_3^-$ , etc.), 10% phosphorus (in the form of phosphoric acid,  $\text{P}_2\text{O}_5$ ), and 5% potassium (in the form of potash,  $\text{K}_2\text{O}$ ). The remaining 80% of the substance is filler. In the case of dry fertilizers, these proportions are percent by weight. In the case of crystalline or liquid concentrates, these proportions are percent by volume of the properly mixed (dilute) solution. One fertilizer I fre-

quently use has the proportions 23-19-17. If the fertilizer is mixed to half strength, for instance, it becomes 11-9-8.

The different proportions of N, P, and K are not especially important in our selection of fertilizers for bonsai. I personally favor a fertilizer that is higher in phosphorus as it promotes good root growth and good flowering for the flowering species. The most important reason to use a balanced fertilizer is to avoid nutrient imbalance problems such as the purple leaves discussed earlier in association with excessive potassium, low nitrogen, and limited magnesium. Additionally, most balanced fertilizers include most if not all of the micro nutrients. Plants require a large number of inorganic elements derived from minerals, supplied from weathering of the soil particles, or mineralized by decay of organic matter.

Colloidal (gelatinous substances made up of very small, insoluble particles larger than a molecule but small enough to remain suspended in a fluid without settling) clay particles and humic (relating to or derived from humus, the organic part of soil) substances have an electrical charge on their surfaces. These electrical charges attract ions and bind them reversibly to the particles. Soil colloids thus act as exchangers. Their exchange capacity depends on the active surface area of the micelles (structural unit). In montmorillonite clay, this area is 600-800  $\text{m}^2$  per gram; and in colloidal-size humic substances, it can exceed 700  $\text{m}^2$  per gram. Both clay minerals and humic colloids have a net negative charge.



## Fertilizer, continued

Consequently, these colloids attract and retain positively charged ions (cations - pron. cat-ions). They also contain sites that are positively charged where negatively charged ions (anions) can accumulate.

This coating of ions amounts to an intermediate stage between the fixed soil phase and solutions in the soil. If ions are added to or withdrawn from the soil solution, exchange of ions takes place between the soil solution and the colloidal particles.

The absorptive binding of nutrient ions offers a number of advantages. Nutrients freed by weathering and the decomposition of humus are captured and protected from leaching. Moreover, the concentration of the soil solution remains low and relatively constant, so that the plant roots are not exposed to extreme osmotic (diffusion of fluid through a porous partition into another fluid) conditions; yet when they are needed, the absorbed nutrient ions are readily available to the plants.

It may not be immediately evident, but these colloidal clay and organic particles that play such an important role in plant nutrition are very small. They easily go through the smallest screen that we use for bonsai soil. There is a message here. Only the very small organic particles are effective nutrient exchange sites in your bonsai soil. If you mix your own soil and discard the fines of the bark mulch, you had better be prepared to fertilize the bonsai often.

An equilibrium exists with respect to the soil solution, the soil colloids, and the reserves of mineral substances in the soil. This system con-

trols the exchange of mineral substances and ensures a continual supply of nutrient elements. The concentration of hydrogen ions in the soil solution (the soil's pH) exerts a great influence upon this ion exchange equilibrium. If the soil's pH is too low (less than approximately 5), or if the pH is too high (greater than approximately 8), the nutrients are largely unavailable to the plants.

Acidity and alkalinity are measured on the pH scale, which runs from 0 (pure acid) to 14 (pure alkaline). From the neutral point (7), the numbers increase or decrease in geometric progression; thus, pH 5 is 10 times more acid than pH 6. Slightly acid soil, about pH 6.5, is best for most plants. There are exceptions, of course; rhododendrons and azaleas require pH 4 - 5.5 in order to thrive. Few plants will survive in soil more acid than pH 3 or more alkaline than pH 9.

Soil pH also has a direct effect on the viability of plants, in addition to its effect on the nutrient supply. Below pH 3 and above pH 9, the protoplasm of the root cells of most vascular plants is severely damaged. Moreover, the increased concentration of aluminum ions ( $A_{13}^{+}$ ) in very acid soils, and of borates in alkaline soils, acts to poison the roots. Most vascular plants are able to exist between pH 3.5 and 8.5.

### Part III: Growing The Tree

If we look at the composition of the plant in terms of relative numbers of atoms of the various chemical elements, we find the following representation for H (hydrogen), O (oxygen), C (carbon), N (nitrogen), Ca (calcium), K (potassium), Si (silica),

Mg (magnesium), P (phosphorus), S (sulfur), Al (aluminum), Na (sodium), Fe (iron) and Cl (chlorine). Nearly half (49.8%) of the atoms are hydrogen. Oxygen and carbon each comprise 24.9%. Nitrogen accounts for approximately 0.3%. The remaining atoms account for about 1% of the total, yet without them plant life, as we know it, would not be possible.

Of course, none of the incorporation of these elements in the plant would take place without photosynthesis. A quick tour of plant physiology will provide a better sense of how these elements are acquired and utilized by the plant.

Photosynthesis is the absorption of radiant energy and its transformation into chemical bonds. Photosynthesis involves photochemical processes that occur in the light, enzymatic processes that do not require light, and the processes of molecular diffusion which bring about the exchange of carbon dioxide and oxygen between the chloroplasts and the air. Photosynthesis is initiated when the chloroplasts (a chlorophyll-bearing body found outside the nucleus in a cell) capture photosynthetically usable radiation light energy in the wave lengths that are visible to the human eye by chlorophyll and accessory pigments.

When light energy is captured by chlorophyll, electrons within the chlorophyll molecule are raised to higher energy states. As these electrons return to their normal orbits, the excess energy is transferred biochemically to the formation of ATP,  $NADPH_2$ , and the breakdown (photolysis) of water which releases oxy-

## Fertilizer, continued from previous page

gen. Energy from these high energy compounds (ATP and NADPH<sub>2</sub>) is then used to convert carbon dioxide to carbohydrates.

At the center of each chlorophyll molecule is an atom of magnesium (Mg). There is approximately 1 mg of chlorophyll in a gram of green leaves (that is 1 part in 1000). Without the magnesium, the chlorophyll molecules cannot be manufactured; and without the chlorophyll molecules, photosynthesis cannot occur. One can easily see why the addition of small amounts of magnesium as a component of fertilizer can have a positive effect on plant growth. Spraying a dilute solution of magnesium on the leaves applies it directly to the site of chlorophyll manufacture.

Photosynthesis is a two part process consisting of a "light reaction" and a "dark reaction." Capturing the sun's energy is one part of photosynthesis. Converting carbon dioxide from the air into carbohydrates is the other part of the process. Carbon dioxide moves from the air into the

leaves through the stomates (minute pores on the surface of a leaf for the exchange of gases) of the leaves by diffusion. The rate at which this gas exchange takes place is controlled by the degree of opening or closure of the stomates. Several factors influence the degree of opening of the stomates. The most influential external factors are light, temperature, humidity, and water supply; the internal factors include the concentration of CO<sub>2</sub> and the amount of water and ions (such as K) in the leaf.

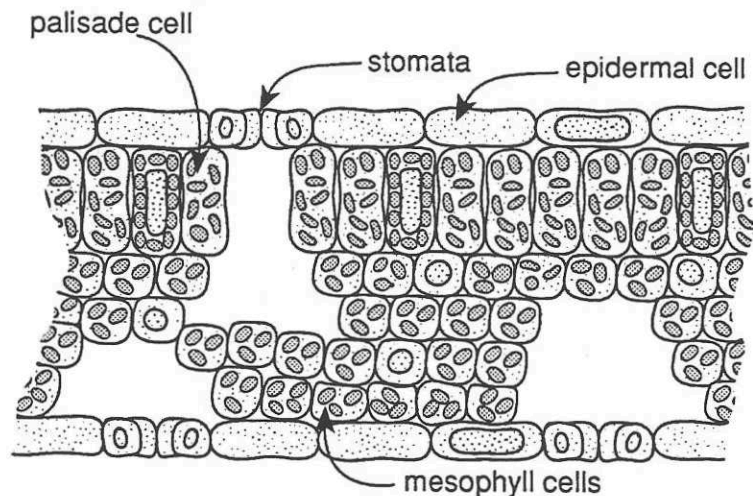
The influence of the nutrient supply upon photosynthesis and respiration is extremely varied. Different effects result from the incorporation of minerals in coenzymes and pigments and their participation as activators in photosynthesis. Manganese (Mn), for example, acts as an activator of photolysis, and potassium (K) is involved in the electron-transport system of the thylakoids. Nitrogen (N) and magnesium (Mg) are components of chlorophyll. Various enzymes include iron (Fe), cobalt (Co), and copper (Cu), while phosphate (P)

is a component of nucleotides (substances involved in enzyme reactions).

The lack of minerals, as well as alterations in the relative amounts of the elements taken up, can effect the chlorophyll content and the number, size, and ultrastructure of chloroplasts. In conditions of nitrogen and iron deficiency, chlorosis (a disease state where the chlorophyll and it's green color are lost in the leaf) is observed, which causes a reduction in CO<sub>2</sub> uptake to less than the normal level. Mineral nutrients further affect gas exchange (the processes of photosynthesis and transpiration) by influencing the behavior of the stomata, and by their effect on other properties of the leaves, such as their anatomical structure, size, life span, and number. Under nitrogen deficiency, small leaves develop with stomata that are less movable, whereas too much nitrogen causes excessive respiration which reduces photosynthetic yield.

The Chart on next page summarizes the way the elements are incorporated and operate in plants, the sites

**Caption** Cross section of a leaf illustrates the upper and lower epidermal layer containing the stomata (pores) through which water and gases enter and exit. The palisade cells contain the majority of chloroplasts where photosynthesis takes place, and the mesophyll cells store the products of photosynthesis for distribution to other parts of the plant.



Element	Function in Plant	Sites of Accumulation	Deficiency Symptoms
N, nitrogen	essential component of protoplasm and enzymes [necessary for a good rate of reproduction, growth and respiration]	young shoots, leaves, buds storage organs, seeds	stunting, spindly appearance, premature yellowing of old leaves
P, phosphorus	basal metabolism and synthesis [breakdown of carbohydrates and transfer of energy within plant]	more in reproductive organs (pollen) than in vegetative	disruption of reproductive processes, delayed flowering
S, sulphur	component of protoplasmic enzymes [aids protein synthesis and may be associated with chlorophyll development]	leaves, seeds	discoloration of leaves and stems similar to N-deficiency
K, potassium	colloidal effect, enzyme activation [necessary for the formation and movement of sugars and starches, synthesis of proteins, cell division and growth, and neutralization of organic acids]	sites of metabolism, cell division	disturbed water balance (tip drying), curling of leaf edges
Mg, magnesium	photosynthesis, phosphate transfer	leaves	stunted growth, interveinal chlorosis of old leaves
Ca, calcium	enzyme activator	leaves, bark	disturbance in growth by division, small cells
Fe, iron	component of enzymes [a catalyst in the production of chlorophyll]	leaves	interveinal chlorosis
Mn, manganese	component of enzymes [assists in the synthesis of chlorophyll]	leaves	inhibition of growth, necroses
Zn, zinc	formation of growth regulators	roots, shoots	stunted growth, discoloration of leaves
Cu, copper	basal metabolism, N-metabolism	woody axes of shoots	tip drying, chlorosis of young leaves
Mo, molybdenum	P and N metabolism [aids the conversion of gaseous nitrogen to usable forms]		disturbance of growth and deformation shoots
B, boron	carbohydrate transport and metabolism	leaves, tips of shoots	disturbance of growth
Cl, chlorine	colloidal effect, enzyme activator	leaves	

of the plants where they are concentrated, and symptoms that are evident when the plants are deficient in particular elements.

#### Part IV: Recommendations

By now, if there is a suspicion that this author is not going to make a recommendation as to what type of fertilizer to use for bonsai, you are absolutely right. There are some things that will be recommended, however. Fertilize trees weekly from the time the buds start to swell until the trees go dormant. Using a variety of fertilizers will help ensure that all of the essential trace elements are being applied. Frequently foliar fer-

tilize trees with an emulsion made up from powdered seaweed. This is a great source of trace elements.

The bonsai soils most frequently used have very poor nutrient exchange capacities. This makes it very important that you fertilize frequently. Some club members have been experimenting with fertilizing daily with very dilute solutions; this should be good for the trees. You are less likely to apply to strong a fertilizer solution by using organic fertilizers rather than inorganic fertilizers. Also, organic fertilizers are frequently applied in a form that only slowly becomes available to the plant. This reduces the burden of

weekly fertilizing. But whatever is done, fertilize bonsai to keep them in good health.

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## Celtic Horoscope, continued from page 6

trious and has manifold talents so that once this person has a goal in mind, it is always attained in spite of a multitude of setbacks. The partner of a cedar person profits from the cedar person's energy and sound optimism. However, because the cedar person is very fastidious, the cedar person has a difficult time finding satisfaction and may wait a lifetime for that one great love. Indeed, adventure-seeking cedar people, for the most part, restrict themselves to an active professional life. 1997 - The February cedar people have an airy philosophy of life that is not rigidly fixed but has a tendency to change. Therefore, they accept what is available and have a preference to engage in mysterious, inexplicable procedures. They are the dreamers of the cedar people who develop and enlarge their fantasies. This tendency is only obvious in stages and shows up mostly in the youthful years. The August cedar people get the opportunity to be wellversed in the artistic metier as an occupation by virtue of their character. For them, a negative lifestyle is next to impossible. All knowledge is defended with a unique tenacity, and it follows that mistakes are unacceptable. Still mistakes can occur. It is also prudent not to be overactive; and during one's lifetime to plunge regularly with enthusiasm into activities, thereby not noticing any precautions. In such periods in your life, you should deliberately let the economy of the situation be the governing factor. It is not always easy to not feel superior and look left or right. In matters of love, a posi-

tive, aggressive behavior is dominant. When such is the case, that person expects the partner, as is generally not the case, to accept that behavior. One should clearly understand that the August cedar people differ from the February cedar people in that the former always face reality. They must learn that a person is a human being; and that the differences between man and woman can never be resolved and be reduced to a common denominator. Cedar people of both 10-day periods willingly fill their minds with ideas and expound personal interpretations of daily occurrences all that not being too much of a burden. Time and again, sociability comes up short. One must jump out of one's own shadow, but here is the question that if by so doing is anyone else helped? PINE ( Feb 19, 28, 29 and Aug 24 Sep 2) 1986 - Often the pine person is somewhat in love with him or herself, and gladly places oneself so that his or chaps can be displayed in prettier and more pleasant company. You are equal to every lifesituation, courageous and ingenious, a good comrade and a very popular pal. You are considerate in friendships but with reservations. You love quickly like a bright flame, yet your redhot passions are only flashes in the pan. Therefore, you frequently experience many disappointments until you find the one who is the fulfillment of your dreams. While in love affairs you are easily offended and all too quick to give up, you prove yourself very resilient in your vocation and also compromis-

ing. Your excellent talents for organization and daring secure for you recognition and success. 1997 - For both the February and August pine people, the notions of trust and love are highly valued. With a distinctly orderly way of thinking, every day is managed in an effortless manner. This cosmic order, the pine people, by actions in the past, indicate that they have the best functioning paths through life. Pine people have a special gift in being able to accurately assess every situation and distinguish the correct from the incorrect, which results in good job advancement. Pine people, because of the cold feeling their pine tree sign may convey, are often credited with being cold but this is very wrong. A pine person only lacks sentimentalism. It is obvious that pine people are frequently criticized, also receive no sympathetic understanding and for the latter reason they most assuredly change their behavior. By all means they can express gratitude and even praise in acknowledging what you may have accomplished. In those cases where intellectual interest arises and it is evident that further action be taken, detailed steps are developed. Prudence is needed when sickness strikes. When it seems that one is becoming ill, all intensive activity must be halted at that time. At no time in affairs of the heart can the pine person cast off an obvious aim to be independent. Apart from that, the February Pine people, when they open up, are unshakeable and a little shy while the August pine women and men, willingly radiant, are the centers of attention. Paradoxically, it is a given that the pine person is at all times in love.

## A Letter from Cliff Goodall, PBA President Not Alone

Editor's note: The following letter from Cliff Goodall was sent to Dr. Joe Gutierrez with a courtesy copy to Clippings, and it points out that Joe's problems with BCI as reported last year in issues of PBA Clippings were not unique. (The correct spelling of Marion's name is Gyllenswan.)

Cliff, I'm sorry it took so long to get the letter into Clippings:

Doctor Gutierrez:

November 8, 1996

Your fiasco with BCI is interesting. Listen to mine.

I was Third Vice President for Bonsai Clubs International a few years ago and my experience was rather odd, in fact so strange that I ended up getting out of all Bonsai organizations and subscribe only to PBA Clippings.

I was scheduled to attend the mid-year meeting in Tennessee, but the night before my departure my wife had an automobile accident. I never left home. The next event was the BCI annual convention in Seattle. Keep in mind that the only Board member I ever talked to was a rather pleasant President Wilma (Name slips me now) from Canada.

My wife and I arrived Seattle full of expectations and hoping to have a good time. Our daughter arrived the following day.

The Board Meeting was called and when I walked into the meeting room the President announced to all, "This is Cliff Goodall from Harrisburg, PA." A few nods my way. It seemed like the main topic of the meeting was the in-coming President criticizing the out-going President. Strange indeed. I was totally ignored, even after the meeting.

The next couple of days attempts were made to communicate with other Board members. No luck. I'm not shy, in fact as a television meteorologist, I was-not given to shyness and able to accept hassle as part of my job. But this got under my skin.

The good thing was that I had made transcontinental arrangements with a preacher man and President Wilma to be present as my wife and I resaid our marriage vows on our 25th wedding anniversary. It was held in the Presidential Suite with Mt. Rainier out the window. All Board members were invited. None attended except Wilma.

Best man? John Naka. Best woman? Marion Gwendellson (spelling?) Who doesn't have a good time with these two in attendance? But the main subject of this letter is that I never was elected to 2nd Vice President and, in fact, was never told there was an election. Any wonder why I pulled out of Bonsai organizations included my own, which I co-founded?

Still in wonderment,  
Cliff Goodall

**Northern Virginia Bonsai Club is scheduling  
Introduction to Bonsai Beginners and  
Advance workshop with Roy Nagatoshi.**

The Introduction to Bonsai Beginner Course will be taught by Pete Jones. He will introduce students to the basic techniques of bonsai through lecture, demonstration, and hands on experience. This 4 session course will include a short history of bonsai, rules, and guidelines for selecting suitable plant materials, techniques for encouraging root and branch development, discussion of soil mixes, and soil preparation based on size and type of tree, placement of trees in the container, and recommendations for watering and fertilizing. Aesthetic considerations will include branch pruning and wiring to create a harmonious balance and aged appearance, container selection, and an introduction to different bonsai styles. At the end of the course, each participant will have created their own bonsai to take home (included in fee). Participants should bring pruners, gardening scissors, a pocketknife, and pliers if they have them.

Tentatively, we asked Roy Nagatoshi if he would be available May 15, 16, and 17, for bring your own tree, wire and materials advanced workshops. Roy is already booked for May 19 through 25.

If there are enough commitments, we can ask Roy for additional days.

If you are interested in the beginner course and/or the Nagatoshi Advanced Workshop, please complete the registration form, circle the date and time you wish, and return it to your club treasurer. Once your requested course/workshop times are confirmed, a \$20.00 deposit will be required to reserve your space.

The balance is due by February 28, 1997.

Registration is limited to 10 per Beginners course/Advanced Workshop

Name: \_\_\_\_\_ Telephone: \_\_\_\_\_

Address: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Dates/Times:

Beginners Course Fee: \$50.00 and the dates are March 29, April 5, 12, 19, 1997

Nagatoshi Advance Workshop Fee \$45.00 per session

May 15, from 9:00 a.m. to 12:00 or from 1:30 to 4:30

May 16, from 9:00 a.m. to 12:00 or from 1:30 to 4:30

May 17, from 9:00 a.m. to 12:00 or from 1:30 to 4:30

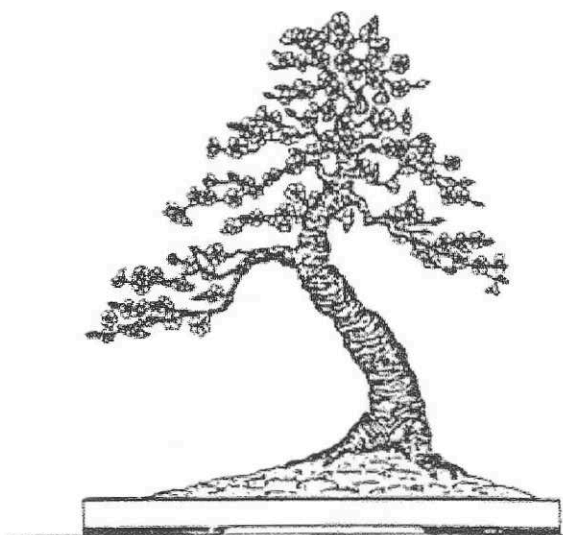
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# POTOMAC BONSAI ASSOCIATION MEMBERSHIP APPLICATION

Welcome! We conduct a Spring Show and a Fall Symposium as well as other events. PBA is made up of the clubs listed to the right. Join one club and be eligible to attend any club's meeting, in addition to receiving *PBA Clippings* monthly. Residents of Annapolis and Baltimore, MD; Lancaster and Philadelphia, PA; Rappahanock, Richmond, Northern VA and the Washington, DC metropolitan areas are expected to join a club to receive all membership benefits including *PBA Clippings*.

**To become a member, call the contact person of the nearest club for current rates and where to send this application and dues. (Please make check payable to the club joined.)**

**Individuals residing beyond commuting distance of a club are invited to subscribe to PBA Clippings.** For a subscription only (does not include participation in club events), complete application and mail with a check payable to PBA for US \$15.00 (US \$35.00 for an international subscription) to: Judy Wise, 1259 4th St., SW, Washington, DC, 20024. For additional information, please call Judy Wise: (202) 554-3045.

*Regular meeting times and places are listed. Meeting times and locations are subject to change. Call first! Events are listed monthly in the Calendar section of PBA Clippings.*

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| <input type="checkbox"/> Individual Club Membership<br>(Includes <i>PBA Clippings</i> )         | <input type="checkbox"/> <i>PBA Clippings</i> , Subscription Only, US \$15<br>(does not include club activities)          |
| <input type="checkbox"/> Family Club Membership<br>(Includes one copy of <i>PBA Clippings</i> ) | <input type="checkbox"/> <i>PBA Clippings</i> , International Subscription, US \$35<br>(does not include club activities) |
| <input type="checkbox"/> Baltimore Bonsai Club  | <input type="checkbox"/> Greater Philadelphia Bonsai Society  |
| <input type="checkbox"/> Bowie Bonsai Club  | <input type="checkbox"/> Kiyomizu Bonsai Club   |
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- BALTIMORE BONSAI CLUB**  
Cylburn Arboretum, Baltimore, MD  
3rd Sunday, 1 PM  
Elaine Kendall, (410) 426-5421
- BOWIE BONSAI CLUB**  
Bowie Community Center, Bowie, MD  
Last Monday, 7 PM  
Terry Adkins, (301) 350-3586
- BROOKSIDE BONSAI SOCIETY**  
North Chevy Chase Recreation Center, Chevy Chase, MD  
3rd Thursday, 7:30 PM  
Jerry Antel, (301) 320-5251
- CHESAPEAKE BONSAI SOCIETY**  
Call for meeting time and location  
Marc Jartman, (410) 263-2748
- GREATER PHILADELPHIA BONSAI SOCIETY**  
Pennypack Watershed, Willow Grove, PA  
4th Thursday, eve.  
Larry Chiger, (215) 663-1678
- KIYOMIZU BONSAI CLUB**  
Clearwater Nature Center, Clinton, MD  
4th Sunday, 2 PM  
Essie Wilson, (301) 839-2471
- LANCASTER BONSAI SOCIETY**  
Manheim Twp. Park, Stauffer Mansion  
Lancaster, PA  
2nd Thursday, 7 PM  
Cindy Kamide, (717) 738-3957
- MEI-HWA PENJING SOCIETY**  
(Chinese language spoken)  
Bowie Community Center, Bowie, MD  
2nd Sunday, 1 PM  
Akey Hung, (301) 390-6687
- NORTHERN VIRGINIA BONSAI SOCIETY**  
Greenspring Horticultural Center, Annandale, VA  
2nd Saturday, 10 AM  
Chuck Croft 703) 978-6841
- RAPPAHANOCK BONSAI SOCIETY**  
Call for time and meeting location  
Todd Stewart, (540) 775-4912
- RICHMOND BONSAI SOCIETY**  
Imperial Plaza, 1717 Bellevue Ave., Richmond, VA  
4th Monday, 7 PM  
Jim Ford, (804) 527-4000, ext 4621
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