On Various Soils and the Use of Perlite

By Greg Moore

Edited and Commentary by George Klump—La Crescenta, California

The question of Ericaceae plants (the heath family) and how best to grow them seems to be a perennial one which sometimes appears to require a different handling in different parts of these United States. It goes without saying that there are different materials available in different parts of the country for the same stated purpose: that of growing ericaceous plants which in this case are azaleas, a member of the rhododendron family of plants. Even including dissimilar climate conditions, soils, and available amendments for those soils, there still remains a common denominator throughout which the azaleas themselves seem to require, if they are to be successfully grown. That commonality is tied up in one word: **drainage**. Without this factor as part of the azalea's requirements, the chances for failure for this beautiful plant increase almost exponentially.

There are some other factors as well, e.g., too much sun exposure and/or too little. The former can cause severe, if not fatal, leaf burn, while the latter tends to discourage the flowering of the plant. It would therefore seem that azaleas are fussy characters which must be treated in just a certain way, else they will not produce their beauty for us. Fortunately, such is not quite the case, but there is no denying that the requirements for success with azaleas do take a little more preparation than just digging a hole in the ground, setting them in it and, then, filling the hole up with dirt and walking away.

Our chapter began in the early to mid-1970's with some experimentation having gone on well before that. We are the Southern California Chapter of the American Rhododendron Society which just last year, 2007, acquired the status of a dual chapter, i.e., we became the Southern California Chapter of the American Rhododendron Society and the Azalea Society of America. There is nothing special about this except the name, since nearly all of us have been growing azaleas for decades anyway along with our rhododendrons.

However, given our geographical spread and the number of different soils with which our membership must contend not to even mention the multiplicity of microclimates, we have been wildly successful in many respects growing Ericaceae here, especially in the face of the received wisdom from all sides, to wit, rhododendrons cannot be grown in Southern California. The support we have gotten from the nursery trade has been more or less nil. Therefore we have been forced to strike out on our own exploring areas of cultivation where even now many professionals in the plant business fear to tread.

Of the different types of soils, we have many in our general area. There is everything from heavy adobe clay to decomposed granite and sand to desert soils which are high in alkalinity. On top of this there is the problem of water, not so much the supply of it, as it is the kind of it, e.g., the amount of total dissolved solids [TDS] it may contain and/or its basic pH over the year. A high TDS reading tends to mean alkalinity, i.e., a pH above 7.0. While Ericaceae will tolerate a pH of 7.0 or even 7 5, higher alkalinity begins to bring on problems which azaleas do not appreciate and which usually result in chlorosis or some other invidious problem which usually results in the eventual death of the plant.

There are many types of soil and soil mixtures. To simplify things we will cite just three kinds of soils here. First, there is clay soil. Clay soil invariably consists of tiny particles which tend to stick together so tightly as to permit very little water circulation through it. A corollary statement could be something like this: If water cannot percolate well down through a clay soil, it is a safe bet that feeder roots of any Ericaceae will not either.

Second, there are the soils found in the desert which may be sandy and light, which is good, but the lack of rain in such an arid climate tends to lead to a buildup of salts. Only a few plants will survive that kind of soil and one sees this with cactus, ocotillo, mesquite, sage, and other plants of similar kind.

A third type of soil is decomposed granite. Decomposed granite or DG is usually quite porous because, unlike clay soil, it consists of relatively large irregular particles which make for spaces between them. We would surmise therefore that larger particles do not cluster together. When DG is mixed with sand, which is also a soil with larger particles, it seems to make for a good general soil base which permits water to penetrate well and drain away. It is this factor which encourages natural microbial and bacterial activity in the soil and which provides a way for soil nutrients to be converted into water-soluble forms which the plant roots, in this case the small feeder roots of Ericaceae, can use. It is this action of soil bacteria, the right kind, of course, which is necessary to the food chain essential to Ericaceae. If water cannot penetrate the soil, one can almost rest assured that oxygen cannot.

Having said this we turn now to our main subject, i.e., various soils and the use of perlite. This article stems from a lecture which Greg Moore gave to the Southern California Chapter of the ARS/ASA in June of 2007, a lecture which was serialized over three issues of that chapter's newsletter by its editor, George Klump. Mr. Moore, himself an expert soil chemist, gave his explicit permission that his material could be edited and paraphrased as needed for that purpose and that, if opportunity arose permitting the further dissemination of his presentation, he would be most happy to see this, too. His insights into planting techniques involving Ericaceae seem so pertinent to the many problems expressed on the azalea yahoo line group, that we felt it appropriate to pass on his thoughts. The following is by Greg Moore in paraphrased form.

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The question is often asked: Just what is perlite? How does it differ from vermiculite? Perlite is a lightweight volcanic mineral [a subgroup of rhyolite] that is composed primarily of silicon dioxide [c.73 percent] and various amorphous silicates, e.g., aluminum, calcium, and potassium silicates. It has essentially no crystalline silica [as opposed to sand which is 99 percent crystalline silica.] There are several forms of crystalline silica, primarily quartz, cristobalite, and tridinite, all of which are harmful if inhaled.

Perlite in rock form has a bulk density of 63 lbs./cubic foot. Because there is water bound up in the rock, it can be heated in furnaces up to 1,600 – 1,750 degrees Fahrenheit to expand it, at which point it becomes a lightweight material, i.e., a bulk density of 2.5 – 10 lbs./cubic foot. It's chemically inert, has a neutral pH, is sterile and is available in a variety of sizes ranging from flour consistency to ½-inch particles.

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Due to its inherent sharpness, it creates particle interference in media and thus generates voids. This provides dimensional stability in a soil, i.e., it resists the tendency of soils to fall prey to interstitial marrying of the fine and coarse particles which clog up macropore space. Perlite acts as a physical wedge to create macropore space between particles, while it possesses multiple and deeply fractured cavities on and in the surface [high micropore space] that trap air and water.

Pumice and scoria also provide macropore and micropore space and maintain long lasting physical wedge action. However, they are abrasive and have much higher bulk densities [c. 30 lbs.& 40 lbs./cubic foot respectively]. They are not as widely used as perlite in propagation because they pack down and can create conditions for rot and can also break delicate transplant roots. In addition some pumice has a high salt content.

We mentioned vermiculite earlier. Vermiculite is not used much anymore in horticulture for many reasons. One is its inherent molecular accordion structure which flexes mechanically under cycles of hydration/desiccation. Before long, the mica plates separate with an attendant loss of airspace as it collapses. Another reason is that vermiculite is expensive. It holds twice as much water as perlite at the same volume, grade for grade. Beyond this there was some asbestos which evidently came from the mine in Libby, Montana—which mine is now closed. Vermiculite does possess some base cation, e.g., magnesium, potassium, and iron, so that it does have some Cation Exchange Capacity [CEC].

There were some peat-perlite blends with various permutations of the two ingredients and of different grades of perlite. The blends could be tailored to a wide variety of propagation needs, e.g., adjusting the pH with calcium carbonate [fine grind lime for a quick reaction] and dolomite. Redco II added a wetting agent for easier and more reliable wetting of the peat. Wetting agents come in many flavors, e.g., the focus being the material to be wetted [organic or inorganic] and whether or not a cationic, anionic or nonionic agent is to be used. Moreover, ester-based agents provide early [but low residual] wetting, but the ester-based agents provide less initial wetting [but better residual effects].

Another consideration was surface tension. Surface tension is the tendency of molecules to adhere to each other. The basic idea is to lower the surface tension of the liquid and chemically penetrate the hydrophobic surface of the peat or wood residual product. [Ed's note: This is why we use the coarse peat moss, since hydrophobic penetration is far better with it than with the finely milled peat moss which eventually can become almost as impenetrable as cement.]

Some of Redco II's principal clients were avocado/citrus growers and outdoor ornamental propagators. The former group typically used a 2/3 perlite – 1/3 peat mixture or an 80 percent perlite – 20 percent peat mixture as a growing medium for the primary seed as well as the nurse graft and etiolated interstem section on clonal rootstocks. The conventional outdoor growers used the 2/3 – 1/3 perlite, peat moss mixture or the 90 percent perlite mixture which latter eventually became known as the Saratoga Horticultural mixture. Good results were achieved with this formulation.

There is a uniform, intermediate size grade of perlite [1/16th-inch – 1/8th-inch] which is used in growing plugs as well as for a seed mulch for selected plant varieties. This is called Provosil® 31-T. As a seed mulch, it has several advantages over vermiculite. Specifically, it holds less water which discourages root bridging [from one plug hole to another at the top]. It also discourages rot and it reflects light around the seedlings which promotes stockier seedlings.

Most of the soil mixes today are variations of the old Cornell University or University of California mixes which included different permutations of sand, bark, peat, vermiculite, and perlite. Today the most common bedding plant mix is comprised of peat, perlite [usually 20-50 percent perlite] or peat, perlite and fir bark, and/or redwood bark.

[Ed's note: We came on to a mix of equal parts of coarse peat moss, perlite, and redwood bark about 28 years ago, i.e., 1 – 1 – 1 by volume. With orchid bark substituted for redwood bark, which E. White Smith of Bovees Nurseries in Portland, Oregon, says is really Douglas fir, the bark should be doubled in volume, i.e., 1 – 1 – 2. We have found that redwood breaks down far more slowly than most any other wood and at the same time the enzymes with the tannic acid from the redwood bark seem to be anathema to most bugs and insects who willingly stay away from the plants in droves.]

There are also plant growth regulators [PGR's] which are commonly used with bedding plants, seedlings at emergence or earlier to control "neckiness" that appears at the cotyledon stage and is thereafter a permanent condition. One must be careful here with these, since overuse can "pygmatize" the crop. Some names include A-rests™ and Bonzi®.

There are also polyacrylamide gels which are not a real solution to water retention problems either. They disintegrate in ultra-violet light of which we in Southern California have more than our share. These gels are expensive and they push soil up and out, when the soil is fully hydrated. Beyond that they may be dangerous because their basic monomer constituent is a powerful neurotoxin. [Ed's note: It has been observed that ultra-violet light down at the root level is not a real consideration. However, in the application of polyacrylamide gels some will, naturally, be first on the soil surface and possibly the leaves of the plant thereby exposing it to ultra-violet light.]

Some nursery tests show that a combination of potassium salts of indole butyric acid [IBA-K], which is a prime ingredient of "Dip N'Grow," and naphthalene acetic acid [NAA], may achieve the best rooting results promoting both root initiation and subsequent root growth for ornamental propagation.

With respect to alkalinity and sodium, many irrigation conditions promote alkaline drift unless treated. Alkalinity is primarily a function of the presence of carbonates and bicarbonates in water. As these increase in concentration, they tie up calcium and magnesium which in turn magnifies sodium problems. This is measured in a higher sodium absorption ratio [SAR]. As this occurs, available phosphorous can increase, while available iron decreases.

[Ed's note: The following is a case study in what alkaline water can do to your plants and why gypsum to increase soil friability, perlite to keep it that way, ammonium sulphate and/or soil sulphur to promote a lower soil pH, are helpful ways to offset both soil and water problems.] A typical interior Ventura County [Santa Paula] water analysis could show water with a pH of 8.5 – 9.5, alkalinity of 150 ppm and sodium [Na] of 90 ppm. These raw water conditions [as with all high alkalinity conditions] require treatment with various combinations of Reverse Osmosis [R/O] particularly for seedlings and/or acid buffering. Carbon filtration for gross particulate and aromatics can augment this.

Acid buffering can entail the use of acid forming fertilizers and/or acid [H2] treatment. In the foregoing Ventura County example, R/O would likely be used for the seedling house and sulphuric acid for the general irrigation to push the pH down to around 6.5 [but not lower than that, generally, with sulphuric acid alone]. Acid-forming fertilizers would likely also be used [ferrous sulphate {FeSO4} by the way has little value, when added to a dry soil mix]. An ideal pH would be close to 6.0.

In field work in high alkaline and in high sodic areas [not necessarily the same areas] of the West, sulphuric acid is more effective in the short term than any form of gypsum [calcium sulphate {CaSO4}] in improving electrical conductivity and SAR values in the leachate. More rapid water infiltration, then, ensues. Moreover, gypsum is safer and easier to handle and in the longer term quite effective in improving these parameters, i.e., drainage and proper water retention.

To wit, gypsum flocculates the soil, i.e., the calcium [Ca] in gypsum aggregates clay micelles, while the sulphate ion [SO4] combines with the sodium [Na] in the soil to form sodium sulphate [Na2SO4], a water soluble salt which is easily leached out in the now more flocculated soil. Gypsum leaves a neutral pH [unlike lime which is also used to flocculate clay soil where acidity is prevalent].

Sodium [Na] is bad news for any soil because it damages the soil and the plants. For example, it corrodes plant roots, burns plant leaves [seen first at the leaf margins] and smears or disperses [sodizes] soil. This results in crusting and low infiltration rates [low permeability] and unusable soil. Therefore a high SAR is characterized by having calcium [Ca] and magnesium [Mg] tied up by high alkalinity [bicarbonates] and thus unavailable to mitigate damaging sodium [Na] at least to the degree that it is present. On a sidebar, members of the Ericaceae family of plants often require soil to have a high calcium-magnesium ratio of close to 4:1 versus the typical 2:1 ratio of most plants.

And as a background note, the competitive ion effect is at work here in all of this. Namely, the Hoffmeister or lyotropic series denotes a hierarchy of ion adsorption to clay colloids in which higher valent cations are more tightly adsorbed than lower valent cations at the same concentrations [meq./liter]. So, for example, trivalent aluminum [A+++] or divalent calcium [Ca++] is more tightly adsorbed than monovalent potassium [K+] or sodium [Na+] and will displace these monovalent ions, if they are available. Ergo, the importance of soil treatment/amendment to free up calcium and magnesium to do their work of displacing sodium.

Besides, the more conventional approaches described above in addressing these issues, the more organic or biodynamic approaches imply green cropping, sophisticated compost sprays and many other more sustainable techniques.

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We have found everything articulated here by Mr. Moore to be most helpful. Some of us have been using the coarse peat – perlite – redwood bark mixture for years and have yet to experience a plant failure because of it. In fact we have found that the faster the drainage, the less tendency for such diseases as phytophthora to get started. The organisms which break down the wood in the mixture appear to be predators of the phytophthora organisms and we have nothing against that. In addition the wood chips tend to provide for space which water and oxygen both need in order to get down to the plant roots. At the same time it makes for an excellent organic mulch which decomposes slowly over time and helps to ensure the general stability of the pH.

It is the drainage factor which tends to forestall any phytopthora or other soil diseases from getting started in the garden. Perlite seems to be a major element in assisting with drainage as well as air space down in the root zone which at the same time promotes the increase of the microbial and bacterial populations which are so essential to a healthy soil and therefore to healthy plants. We have found that Ericaceae will take just about all the water they may receive so long as it drains away from the roots just about as rapidly as it comes in. It has been recently noted that phytophthora is now arguably the most destructive plant disease in the world. A fast draining soil discourages phytophthora. Perlite promotes fast drainage and soil stability. That seems like a good combination.

George Klump *is a resident of La Crescenta, California, a musician by profession, a concert organist and teacher of orchestral and choral ensembles as well as a church musician. He came to gardening naturally through his paternal grandmother and his father, also a musician and banker, who raised more than 100 roses plus camellias, fuchsias, poinsettias, chrysanthemums and cannas among other plants. He has always had an interest in azaleas and rhododendrons, the parent family. He has been a member of the Southern California Chapter of the ARS [as of the spring of 2007 also a dual chapter, i.e., ARS/ASA] for 30 years and for three years was its president. He currently edits the chapter newsletter and is vice-president for chapter projects and publications. His own collection of plants includes many rhododendrons, lepidote and elepidote, as well as azaleas, including Satsukis, camellias, chrysanthemums, fuchsias, hibiscus and roses.*

Society News

Alliance formed to preserve old azaleas

The Great Gardens of America Preservation Alliance has formed to identify and preserve ancient camellias and azaleas (those propagated before 1900) and historic ones (plants from 1900 to 1960).

The alliance (greatamericangardensalliance.org) believes there are about 470 ancient and historic camellias but only about 100 azaleas. The group is starting its search in public gardens and wants to save, catalog, propagate and preserve the DNA of vanishing breeds that may have fallen out of favor but represent the history of the plant, which first came from China to Western Europe 300 years ago.

Group studying idea of research foundation

The ASA Board recently established a committee to study the feasibility of creating an azalea research foundation.

Past ASA President **Jim Thornton** is chairing the committee. Members include former ASA Treasurer **Bob Stelloh** and ASA President **John Brown**.

The committee is also charged with investigating and making recommendations as to the form and format of the foundation, if its creation is recommended.

The committee is expected to make its report and recommendation to the Board by the end of the year.

For more information, e-mail jimpatsy@comcast.net.

Call for articles

The Azalean needs more good articles about azaleas, their care, and their use in the landscape. Ideas for topics include:

- Articles describing new public gardens or special azalea collections being created in your area.
- Descriptions and photographs of Society members' gardens.
- Current research on azaleas.
- Information about azalea festivals and sales.
- Historic garden restoration stories.
- Articles about noteworthy azalea hybrid groups or new species or cultivar introductions.

Articles should be submitted as Microsoft Word documents. Illustrations are highly encouraged. Photos should be 4 x 6 inches at 300 dpi resolution.

Submit materials to:

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