

PINE BONSAI FOLIAGE CONTROL

By Julian R. Adams

Foliage is one of the major elements used in the design of a bonsai. The size and location of foliage on the limbs is of great importance in creating the desired representation. It is almost always helpful if the bonsai foliage is small and in scale with the size of the design. Having foliage appropriately distributed on the branches, not just at the tips, is important for most designs.

The natural growth characteristics of pines make managing the size and location of the needle clusters (foliage) a bit more challenging than with deciduous trees. Managing the foliage of pine bonsai is not difficult in itself. The difficulty lies in the fact that it may take two or three years for needle control techniques to take full effect. A certain amount of self-discipline and patience is required of the bonsai artist who wishes to maintain the best possible foliage on his pine bonsai.

This article will examine needle control techniques for pines commonly found in bonsai collections in the temperate regions of North America: Scots (*Pinus sylvestris*), Japanese white (*Pinus parviflora*), Mugho (*Pinus mugho*), Ponderosa (*Pinus ponderosa*) and Japanese black (*Pinus thunbergi*).

Foliage reduction and location techniques for deciduous trees are very similar for most species. The focus tends to be on short periods

Scots pine—
New buds forming.



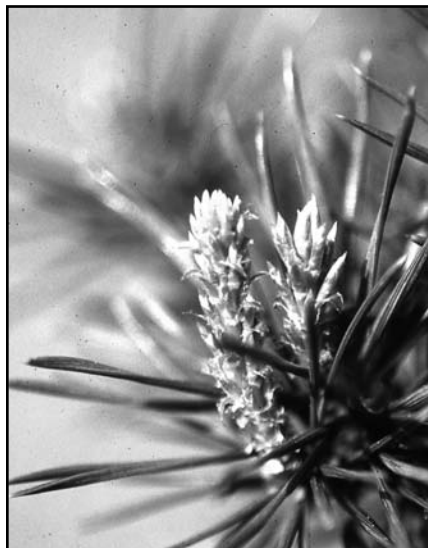
JULIAN ADAMS PHOTOS

during the growing season with the certainty that all of the foliage will drop in autumn and next year will present a clean slate for a fresh start. Pines are a good bit more interesting because the needles persist for two or three years. This means that a minimum of two or three years are required for pines to show the full effects of properly applied techniques for foliage location and size. This is not long in the life of a bonsai but may appear to be unpleasantly long for those of us who are challenged with impatience. Added interest comes from the fact that for needle size reduction, black pine techniques are quite different from the techniques used on most other pines. Thus, Japanese black pine needle reduction will be dealt with in a separate section.

Pine Needle Growth Cycle

Although much has been written about the control of pine foliage, many of us remain confused. I believe that the confusion has less to do with the complexity of the techniques than with the lack of clear definition of the terms used to describe the techniques. To help the

Scots pine—
New needles forming.



reader understand the specific definitions as discussed here, I will describe the annual growth cycle of a pine, focusing on the production of new needles. Important terms are in *italic*.

Pine Buds

The pine *buds* are arranged in a cluster at the tip of the previous year's growth. There may be only one *bud* or as many as seven or eight *buds* at the terminal. Each *bud* is an ovate shape covered by tiny scales and slightly pointed on the outer tip. One of the *buds* will normally be much larger than the others in the cluster. In most instances, this dominant *bud* will be in the center of the cluster. When temperature and light conditions are right in the early spring, the *buds* begin to swell. As each *bud* swells, its tiny scales enlarge, becoming more distinct. Some green color can be seen in the *bud* where none was visible in the dormant season.

Pine Candles

As spring warming continues, the *buds* lose their characteristic shape and elongate into *candles*. *Candles* are cylindrical growths formed as the scales and central core of the *buds* grow longer. At this point, the *bud* ceases to exist, having been transformed into a *candle*. *Candles* mostly grow in length from the tip. Depending on

Scots pine—
Pinched candles growing.



the vigor of the plant, a *candle* may grow to more than two feet in length in the expansion period which lasts between two and three weeks.

Pine Needles

As the *candle* lengthens, each scale transforms into a *needle* cluster, five *needles* per cluster for Japanese white pines and two *needles* per cluster for Scots, Japanese black pines, and the others under discussion. A single *needle* cluster can be considered to be a single leaf of a pine. The *needles* are quite small when they start to emerge from the scales, giving the *candle* a prickly appearance. In a couple of weeks the *needles* reach their final mature size.

Pine Shoots

As the *needles* lengthen, a point is reached when the *candle* shape is lost and the totality of the new growth is called a *shoot*. A *shoot* consists of all of the *needle* clusters and their supporting stem which have emerged from a single *bud*.

When the *needle* clusters at the tip of the *shoot* reach their final size, a tiny beginning of *buds* for next year appears at the tip of the *shoot*. Coincidentally, the translucent spring green color of the *needles* darkens. At this point in the annual cycle, the *needles* have "hardened off", a term that means the *needles* are mature and will never further increase in size. The remainder of the growing season is used by the *needles* to conduct photosynthesis which provides the energy to fuel the needs of the tree. During the latter portion of the summer the beginning *buds* increase in size and number according to the growing conditions.

Normally no further growth takes place until the cycle is repeated the

following year. *Needle* clusters persist for a minimum of eighteen months, sometimes much longer. At any given time, the newest *needles* are closest to the end of a branch.

Due to differences in growing conditions, *needles* from different years may exhibit differences in size, color, etc. When the tree has no further use for old *needles*, they turn brown and drop from the tree. This mostly happens in the fall but happens to a lesser degree at other times.

Back Budding

Before needle reduction techniques are put into effect, there must be foliage at the desired positions on the limbs. Deciduous plants tend to sprout new growth easily and rapidly from old wood when encouraged by methods such as severe pruning.

Pines are much less inclined to sprout from old wood and they certainly do not do it rapidly or easily. Back budding or adventitious growth is mostly from needles that have not dropped from the tree or in portions of wood which have thin bark.

Severe pruning, which removes all foliage from a limb, will normally bring about lush back budding in deciduous trees. The identical operation on a pine (removal of all needles) will result in no budding on that limb and the limb will certainly die. Thus, for pines it is of major

importance that limbs and twigs be maintained with foliage close to the trunk. This assures that there will be needles present to give rise to adventitious buds in addition to those that appear annually at the end of the current season's shoots. It is very difficult and takes a long time to restore a pine whose foliage has all migrated to the ends of spindly limbs.

When the need arises to create back budding, a combination of actions will encourage the desired result. First and foremost is to give the tree the maximum possible direct sunlight. Pines are sun lovers, suffering greatly if not given enough direct sun. Bright light isn't enough.

Substantial shade is a recipe for steady decline. Strong sunlight will encourage budding in the center of older needle clusters and occasionally on bare wood. The greatest need is usually to have the adventitious buds appear on bare wood. This is most likely to occur on younger twigs but will happen on older wood occasionally. Judicious removal of thick bark on the twig without damaging the cambium seems to enhance the probability of bare wood budding. Twigs that are wired and bent for design reasons seem slightly more likely to bud on bare wood than normal.

Various methods involving the removal of old needles are used to increase sun exposure and thus greater back budding. Certainly one should remove all dead needles at the proper season. The occasional

Japanese black pine—
Vigorous new candle forming.



Japanese black pine—
Candle elongating.



Japanese black pine—
Cutting shoot to develop short needles.



green needle cluster will remain on the twig where most have died and dropped off. These persistent needle clusters should not be removed as they often will develop a new bud in their center.

Wiring and other training work should be done carefully so as not to remove or damage these points from which new foliage is likely to develop. New growth from adventitious buds (those buds not at the twig terminal) is very fragile for a couple of years and should be treated with care until it achieves some substance. If one employs techniques for the removal of green needles, either plucking or cutting, the orientation of adventitious buds will likely be more suitable if needles oriented horizontally (left and right) are saved and vertically oriented needles (up or down) are removed. Green needle removal techniques are usually safe on the very vigorous Japanese black pines but should be used sparingly on most other pines.

Vigorous, healthy plants are better able to provide the energy needed for back budding. Heavy feeding after the needles have hardened off helps the tree maintain top strength while not causing any increase in needle length. The bud formation season is late summer and early fall. To give an extra boost in bud making, application of fertilizers intended for the stimulation of roots and blooms has been quite successful. Several commercial products of this sort are available at garden centers. They are identified by the unusually

Japanese black pine—

Shoot removed to encourage new candles.



high middle number which specifies the percentage of available phosphate. The product I am currently using has an analysis of 10-60-10. In the Virginia foothills of the Blue Ridge Mountains (U.S.D.A Zone 6.5) this formulation is used from the latter part of August until a week or two into October.

A third key to promoting back budding is understanding the significant effect of existing buds on the branch. Large terminal buds on a branch substantially suppress the development of small existing buds and the hoped for emergence of adventitious buds closer to the trunk. This is a natural characteristic of a plant that needs strong sunlight on its leaves to survive. Inner foliage is likely to be shaded in nature, providing little energy to the tree in return for the energy expended in creating that foliage. The outermost buds are likely to produce the best result in competing for sunlight, particularly if they are large and capable of the greatest extension of the new growth in spring. When the large terminal buds are removed, the tree diverts its



Japanese black pine—
Second buds forming.

Japanese black pine—
Second flush of new candles.



resources from the terminal and encourages all of the buds on the branch equally. Removal of terminal buds, especially large ones, will greatly encourage the smaller buds as well as promoting the creation of new buds elsewhere on the branch. This can be done at any time from early fall until late winter. Early fall removal of the appropriate terminal buds seems to have a greater effect than late winter removal on the production of new buds for the next spring. Late winter removal usually creates buds during the subsequent late summer that will open in spring of the next year. Late winter removal of large buds is just as effective but does delay most of the desired result by an entire growing season. If a particular twig seems especially strong at the tip, removal of the terminal bud and a portion of the newest needles is also effective. Judicious bud removal is regularly used as an energy management technique for equalizing the strength of all portions of a pine bonsai.

Pines differ in their ability to dependably bud back on older wood. When properly encouraged, Japanese black, Scots, Ponderosa, and Mugho pines (two needles per cluster) are reliable producers of adventitious buds on wood that is not too coarse. Most Japanese white pines (five needles per cluster) are far less responsive. Because of this difference, Japanese white pines are more difficult to recover from neglect or improper care. Japanese white pines whose foliage has migrated too far from the trunk may require grafting to recover the desired bonsai style. It should be noted that certain dwarf cultivars of Japanese five needle pine, such as 'Zuisho', are much more enthusiastic about back budding and respond almost as well as the

Japanese black pine—
Second flush of new needles.



two needle species.

Needle Size Reduction

The most unpleasant characteristic of Japanese black pines in bonsai use is that the needles tend to be much too long to be in scale for the typical bonsai. The unusual vigor of Japanese black pines is used to overcome the long needle problem. When the training of a Japanese black pine bonsai has progressed to the point that short needles are required to complete the design, a procedure unique to Japanese black pines is used. When the buds start to elongate in spring, the bonsai is fed and watered generously to promote maximum growth as the buds expand into candles and then shoots.

As the candles elongate those of unusual length may be pinched back a little to equalize the length of the candles on the entire bonsai. As the shoots near maturity in mid-summer, they are removed by cutting them back to the base of each shoot. Because of the great vigor of the Japanese black pine, new small buds will form at the tip of last year's wood where the new shoots were cut. Instead of remaining in the bud stage until next spring, these new small buds will extend into a tuft (small shoot) of new needles right away. The new needles in the tufts will be substantially smaller than the first set produced in the spring and much more in scale for the bonsai design.

Once this basic operation is understood, there are more advanced nuances that can be added to fine tune the energy distribution on the bonsai by suppressing the plant's natural apical dominance. It should be further noted that a real bonsai may not always have buds of equal strength. Where the buds are very

weak, the practice of shoot removal may cause loss of the weak branch. Weak branches should be passed over for shoot removal and allowed to strengthen for possible inclusion the following year.

Scots, Ponderosa, Mugho, and most cultivars of Japanese white pine trained for bonsai respond favorably to the following techniques. Pines, with the exception of Japanese black pines, are seldom vigorous enough to produce more than one crop of needles and buds each year. This pleasant limitation greatly simplifies needle size reduction for all pines except Japanese black pines. Energy management techniques, discussed in a previous article, are related to needle length reduction. Removal of larger than normal buds, especially in overly vigorous portions of the bonsai, encourages back budding and diverts energy to weaker buds and weaker portions of the tree. Increasing the number of buds helps with needle reduction because the greater number of growing points leaves less energy available for each point, resulting in smaller needles.

Back budding helps because needles from new adventitious buds are always smaller than normal. Finally, needles from smaller buds tend to be smaller than needles from large buds. A bonus of the smaller buds is that they are unable to produce long candles, making it easier to control the overall growth of new foliage.

If the energy management techniques have been properly applied, budding and existing needle size should be uniform over the entire bonsai. With this starting point, needle size reduction is very simple. First, give the maximum possible direct sunlight at the earliest

sign of bud movement in spring. As the growth process proceeds, withhold all fertilizer until the new needles have hardened off (the point of first appearance of beginning buds for next year).

Water should be restricted as much as possible without threatening the plant's survival during this same period. Application of all three of these conditions during this critical period when the new needles are being formed will remarkably reduce needle size, even for the larger needled species such as Ponderosa pine.

Withholding fertilizer is easy enough but rainy periods can sabotage the best of intentions to reduce water availability. An occasional rain is of little consequence but a week or so of continuous rain and heavy clouds may call for counter-measures of some sort if it occurs just as the new needles are reaching the maximum desirable length.

Foliage Extension

Overly long needles can be brought into proportion in about two years. However, even one year of failing to candle pinch a bonsai in this group of pines can result in great disruption of the intended design. Repair of such a situation may take many years if it is possible at all. The quantity of new needles produced is not directly related to needle length but is absolutely tied to candle length.

Candle pinching is the prime means of controlling the quantity of new foliage added during the year's needle production period. Each of the scales that make up the bud (and later the candle) will produce a needle cluster, two needles for Scots, Ponderosa, and Mugho, five needles for Japanese white pine, etc. As soon as the candle has elongated enough

Zuicho Japanese white pine—
Candles forming.



Scots Pine—
Pinching candles with fingers.



Scots pine—
After pinching candles.



that the lengthening scales are individually distinct one should pinch the candles back to the desired length. This determination of where to pinch is guided by the knowledge that the candle will not elongate further after pinching occurs and that each scale on the remaining portion of the pinched candle will produce a single cluster of needles. One can actually determine the exact number of new needle clusters that will be produced by counting the scales on the remaining portion of the pinched candle. Although ultimate needle length is not directly related to the pinching of candles, needles seem to grow a bit longer from candles that are not pinched until considerable excess length of candle has been allowed to develop. The best result seems to be achieved by candle pinching when the scales are clearly distinct but before the new needles extend more than one-sixteenth of an inch.

Once the needles have hardened off, enthusiastic fertilization and watering will strengthen the tree but will have no effect on the needles or shoots. Neither needles or shoots will grow longer after hardening has taken place. As mentioned earlier, switching to fertilizer with very high phosphate content in late summer will promote extra buds for the next growing season. Extra buds serve multiple purposes. They help create new foliage close to the trunk, give additional flexibility in maintaining the design, and help maintain smaller needles through the increased number of growing terminals (which further divides the tree's total energy).

Shoot removal is almost never recommended for needle size reduction except with Japanese black pines. For all others shoot removal is

really a form of pruning, used to chase back overly long branches or encourage back budding for next year's growth. Care should be taken that shoots not be totally removed unless there is a reasonable group of healthy needles behind the point where the cut is made.

Foliage Health

Artificial soils provide great drainage for pines but may be lacking trace elements critical to good foliage (and tree) health. Japanese white pines, especially 'Zuisho', seem to be more sensitive to trace elements than the two needle species. Poor foliage color is a key indicator of this problem. A trace element supplement with proper ratios of its components can bring about near miraculous improvement in needle color.

Micromax® is one commercial preparation designed specifically for this problem. This is not a fertilizer. It is a water soluble blend of essential elements in proportions needed by most plants. Common practice is to trust that micronutrients from fertilizer or the bonsai soil mix is sufficient. Unfortunately, this is seldom the case. Bonsai need the trace elements during the brief time period each year when the needles (leaves) are being created by the tree. After the first month of watering, soluble trace elements added to soil mixes have been largely flushed out, becoming unavailable for subsequent life processes of the bonsai. Trace elements in fertilizer are of little use if the trace elements are needed during the period from bud break to needle hardening, a period when fertilizer is withheld to promote short needles. For more than ten years I have applied Micromax® to the bonsai just prior to spring bud break. Superior

needle (leaf) color and general plant health have resulted.

There are other methods of maintaining healthy foliage but the use of micronutrient supplements seems necessary when a soil mix such as mine (80% Turface®) is used. An added benefit is the acidification properties of Micromax® which helps offset the high pH, often 7.5 to 8.0 of most municipal water supplies.

Fungal disease can cause great harm to pine bonsai. Two needle pines seem more susceptible than those with five needles. Wetting pine foliage should be avoided at all times during daily watering. Application of a fungicidal spray, e.g. Daconil®, once or twice after needle hardening is a recommended prophylactic procedure. Dormant season spraying with lime-sulfur is also recommended. Fungus infection of pine needles is disfiguring at first but can rapidly progress to the point of threatening the life of the tree. It is likely that needle fungus is a greater problem for bonsai in the United States than is commonly recognized.

Taken as a whole, the techniques discussed above may seem complicated and difficult. This is not really the case. Taken by variety, the techniques are logical, sequential, and change little from year to year. Properly applied, much of the mystery disappears from maintaining proper foliage on pine bonsai. The bonsai enthusiast can then fully devote his artistic resources to the creation of the best possible designs with pines, the aristocrats of bonsai material.



ABOUT THE AUTHOR Julian R. Adams

Julian Adams is a bonsai author, instructor and exhibitor from Lynchburg, Virginia. He is the proprietor of Adams Motors Company and Adam's Bonsai, a retail bonsai business.

Mr. Adams experiments with various propagation and growing techniques and his engineering background has led him to new innovations in cultivating and training bonsai. This background has also provided him with a solid background for designing and constructing his bonsai garden and other innovations. He is especially interested in pines and had done considerable study on the techniques required to develop short needles and back buds.

Annealed copper wire is one of his specialties and Mr. Adams supplies many nurseries with the traditional training wire. Mr. Adams has authored several articles in past issues.

Japanese white pine—
Remove old yellow needles.



Japanese white pine—
After removing old needles.

