Pine Management Theory

Part 1

By
Greg Cloyd

Introduction

The 1999 International Bonsai Symposium on Pine Bonsai caused me to examine my own struggles to master pine bonsai culture. The symposium was a wonderful review, but afterwards, reflecting on the format of the lectures with Dennis Makishima, we concluded that the time limitations were too great to adequately sort out the many, seemingly contradictory aspects of pine culture. This article is an attempt to explain how pines grow in bonsai culture, including the theory, application and timing of common pine bonsai techniques, why varying species of pine are treated differently and how to recognize a healthy pine.

The Best Teacher Of Pine Culture Is The Pine Itself

Serial observations of pine trees after varying stresses, cuts and growing seasons teach the grower what to expect. It is also helpful to find good pine growers and carefully observe their trees and techniques. This article is an attempt to allow the reader to vicariously learn from the observations of some of the most experienced pine growers in the United States.

Genus Pinus

The most obvious feature characterizing the genus *Pinus* is that pine leaves are needle shaped and occur in clusters. Unlike familiar deciduous species, most northern temperate pines have only a single spring flush of growth under normal circumstances. Like deciduous trees, pines annually have foliage yellowing and leaf drop in the fall. Unlike deciduous trees, pines shed only their oldest needles. They retain new needles for three to five years, thus the evergreen appearance.

Mastery of pine bonsai culture is difficult. Trees of the genus *Pinus* are frequently misunderstood or avoided by bonsai growers. After initial experiments with grocery store purchased junipers, most people begin their serious bonsai study with deciduous trees. These deciduous trees continuously produce new shoots and leaves throughout the growing season, thus growth is continuously removed. The deciduous techniques of pinching, or ongoing pruning, during the growing season, being the first mastered, become the most comfortable for many growers. These techniques are inappropriate for pine culture. Appropriate pine techniques are really no more daunting once properly explained; they are simply different.

WM N. VALAVANIS PHOTOS

Zuisho Japanese five-needle pine, Pinus parviflora *'Zuisho', trained in the informal upright style. This bonsai was propagated from a graft or airlayer and was exhibited in the 20th Annual Grand View Bonsai Exhibition in Kyoto, Japan.*

Editor's Note: This article will begin a rather technical comprehensive series on training pine bonsai by Greg Cloyd. He has intensely studied and researched pine bonsai theory and has taken the time to offer our readers the results of his work.

"Pine Management Theory" will continue in the next several issues of International BONSAI.

The Main Cultural Requirements For Pine Bonsai–

Full Sun, Excellent Soil Drainage And Good Air Circulation

If these requirements are combined with appropriate vigor balancing techniques, extraordinarily beautiful and long-lived bonsai may be produced which actually require less annual care than most deciduous bonsai.

Pines are very shade-intolerant and extremely top, or apically, dominant. A large central dominant bud develops on the growing tip of each new pine shoot shortly after the shoot is produced. Later in the season, secondary buds appear at the base of the central dominant bud. This collection of buds is called a terminal bud cluster. The location of the terminal bud cluster is called a node. This nodal bud arrangement results in an annual whorl of subordinate branches surrounding an apically dominant leader rather than the alternate or opposite leaf and branch patterns of most deciduous trees. The location of each whorl of branches is also called a node. The distance between each node or whorl of branches is the internode.

The most dominant, vigorous and largest buds of a pine will appear in the center of the bud clusters on the branch tips of the upper and outermost areas of the tree. These dominant buds can produce new growth up to a few feet in length. Dominant buds receive the lion's share of sunlight and sap flow, and additionally produce suppressant hormones to control and diminish growth behind and below them.

Under normal circumstances, most of a pine's growth and vigor will be limited to the outer and uppermost branches of the tree. The resulting lion's tail configurations are unsightly on a plant of bonsai scale. This genetically determined imbalance of strength is one of the main challenges of pine bonsai. Once the techniques for balancing vigor are mastered, pine bonsai culture becomes much more enjoyable and productive.

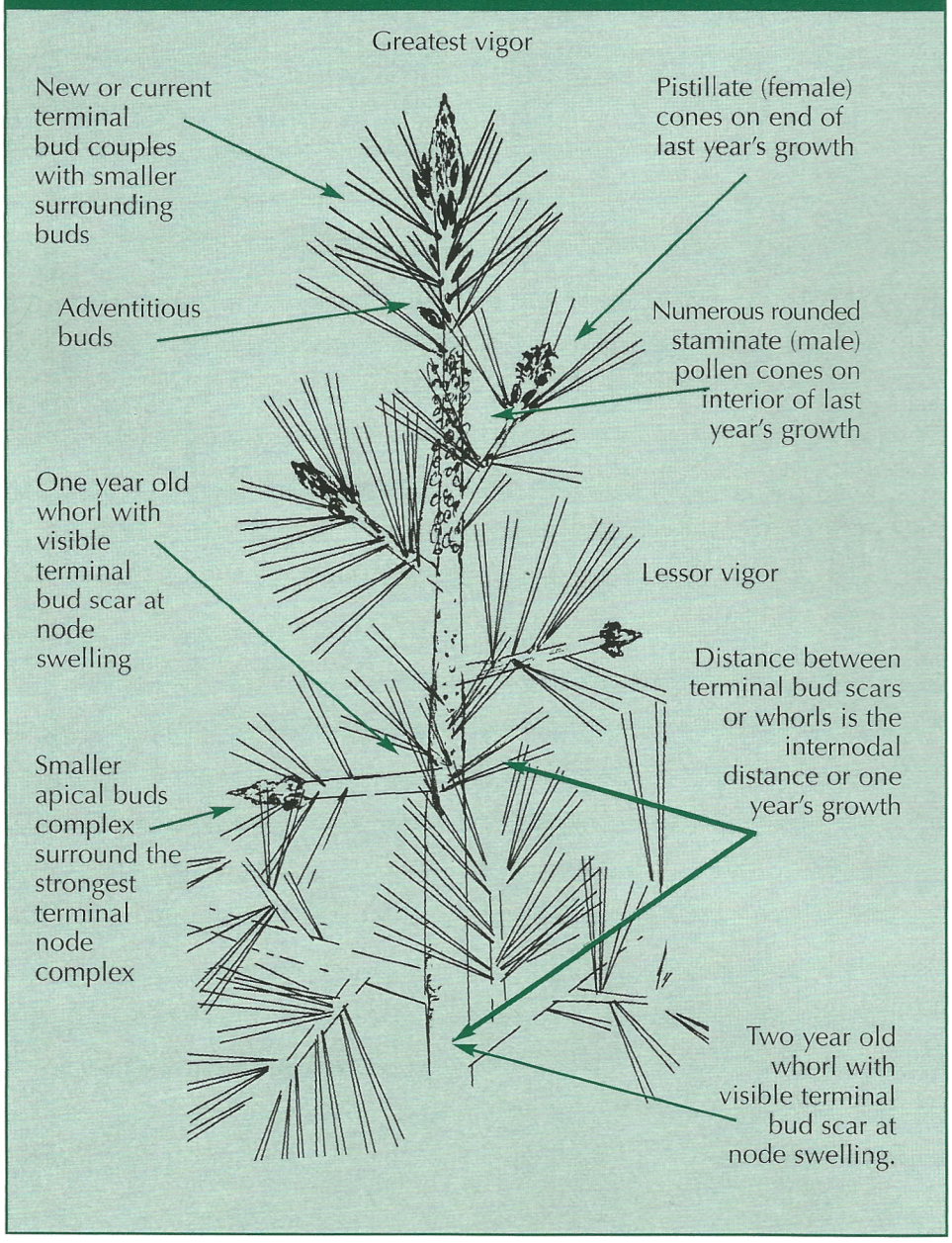
Primary branches lower on the tree and secondary branches on interior portions of the tree have the same terminal bud clusters located on the branch tips. However, their terminal bud clusters are much smaller in size and number compared to apical areas of the tree because of the hormonal suppression and lesser sun exposure. These weaker buds produce shoots much smaller in length and diameter. These weak areas also produce shorter, finer needles.

The strong apical dominance of pines results in a single strongest terminal bud cluster dominating the terminus or leader of each branch and a single dominant branch leader dominating the tree. This dominant terminal bud is the master bud of the branch and is, jokingly, referred to as the "Elvis" bud. The "Elvis" bud commands the growth of the branch. The strongest terminal bud of the strongest branch is, of course, "The King" of the tree.

The strongest upper shoot of a pine tends to grow vertically and position itself over the buttress of the tree. The tendency for the top of the tree to grow directly over the buttress reduces structural stress on the trunk by decreasing the likelihood the trunk will be pulled into a leaning position by gravity. This is referred to as negative geotropism and is one of many ways that trees use to distribute stress uniformly over their surfaces to allow them to bear maximal loads while investing minimally in structural material.

Phototropism (growth toward light), apical dominance and negative geotropism are the main, above ground, growth determinants of

Fig. 1– Parts Of A Pine Branch



pines and explain the strong tendency for pines to grow straight and vertical. Tree shape ultimately reflects a balance between environmental stresses and genetically programmed growth determinants. Apical dominance rewards the uppermost shoots and helps in an upward race for light openings in the forest canopy. Additionally, apical dominance directs the orderly positioning of lower and inner foliage for maximal photosynthesis.

After the death of an old apex when the race for dominance rages between multiple branches, negative geotropism in partnership with apical dominance declares the shoot reaching highest over the buttress the winner and new apex. Phototropism trumps all. A structurally sound and dominant position is worthless without sunlight, the ultimate energy source.

Downward growing buds, interior buds and shaded buds receive less sunlight and are hormonally suppressed. Over time the strong upper and outer portions of the pine will continue to grow in strength and the weak lower and interior portions of the tree and the undersides of branches will continue to lose strength until they become bare and die. This results in the heightened definition of negative space between branches so pleasing in pines.

When a pine does not grow vertically it is often due to phototrophic reaching toward light. Injury to the tree or underlying unstable ground may also lead to crooked growth patterns. Strong winds and snow loads frequently cause pines to bend. If the vertical space around the tree is occupied by some other object, such as another tree, cliff or fallen snag, the tree must alter its preferred upright growth form.

Once these restrictions are removed the pine will return to its vertical growth form until age and the physical limits of water and nutrient flow limit its upright and conical form and force it to assume a more rounded and mature shape.

In post-mature and very old trees the rounded form gives way to an open form with multiple dead branches and a few very thick remaining branches that each have their own rounded sub-apexes. Senile trees possess ancient, ravaged and hollowed trunks dominated by stagheaded deadwood with small twisted cambial lifelines and minimal live branches.

The Story Of A Tree

Each year trees lay down a new annual growth increment or ring of wood. In areas of injury or stress the rings are thicker in order to reinforce stressed areas and close wounds. These thicker rings are called reaction wood, Study of the architecture of tree rings yields both a history of previous weather, injury and structural stresses on the tree as well as a history of the resources, especially water, available to the tree. The study of the spacing and structure of tree rings, as a study of the past is called dendrochronology.

Studying the external form of the tree also yields clues to its history. Solitary versus grove environments and nutrient rich versus nutrient poor conditions yield strikingly different tree forms. One-sided growth often indicates shading or heavy wind influences. The overall height and diameter of the tree trunk, as well as, the number and length of internodes can give an estimate of the age and environment of the tree. Tree age estimates are most accurate when compared to dendrochronologically dated trees in the same growing area.

Above and below ground the tree struggles to form a structurally sound framework that is just sufficient to meet its needs without wasting resources. After stress and injury or when competing for resources and light, strange forms may emerge. Each twist and turn, no matter how seemingly bizarre yields a clue to previous conditions. The growth principles are logical. The tree's pursuit of survival is relentless.

Lurking Within The Tree's Current Form Is The Story Of Its Past

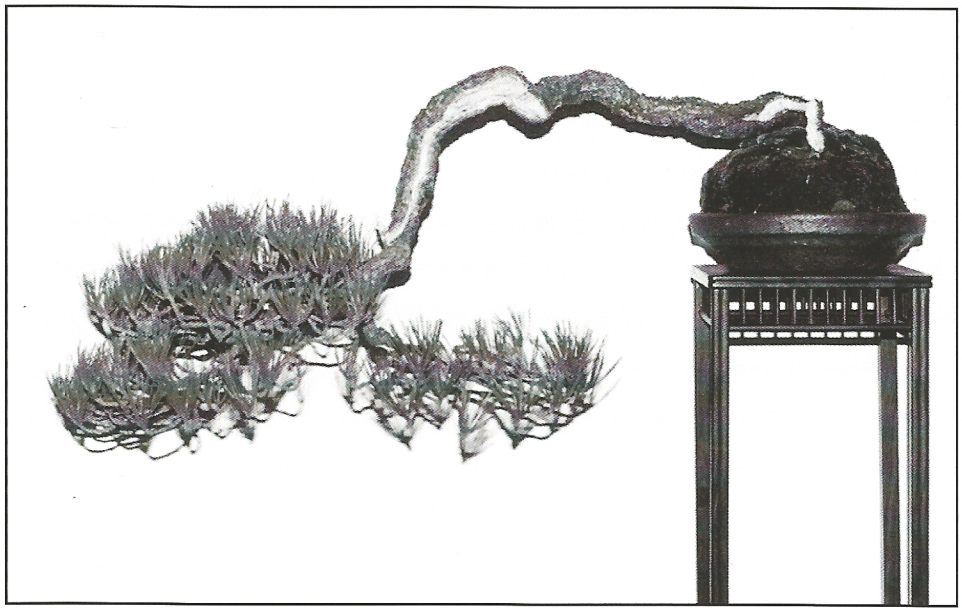
Examining the tree's surroundings along with its trunk line, silhouette, twists and scars helps to form a mental history of the tree. This is what naturalists and bonsai artists refer to as the story of the tree.

Understanding the story a tree has to tell and learning to enhance those details which make the story clearer and more believable is much of what bonsai is about. After studying these stories it becomes obvious that many individuals of the same species communicate similar sentiments. These repetitions of evoked response are known as the spirit of the species or genus. Pines the world over survive in difficult circumstances, attain great age and dignity and evoke a sense of timeless tranquillity.

Age, Tranquillity And A Sense Of Timelessness Are The Spirit Of Pines

Age is communicated with gripping roots and craggy bark. Tranquillity and timelessness derive from the cleanly spaced and unchanging evergreen boughs. Understanding what each form and twist indicates in the language of a tree and understanding the underlying growth

Japanese red pine, Pinus densiflora, trained from a collected tree and trained in the cascade style with driftwood. This bonsai was displayed at the 20th Annual Grand View Bonsai Exhibition in Kyoto, Japan.



principles is the first step toward being able to manipulate trees in a sustainable and credible way.

Enhancing the story of each individual tree, while respecting the spirit of the species, will allow you to evoke credible mental landscapes of great power within your viewers.

Japanese Black Pine: The Model For Pine Bonsai Management

Japanese black pine, *Pinus thunbergi,* is a warm environment, coastal tree. The buds are a white or cream color at sea level. At higher elevations in Japan, Japanese black pines possess reddish-brown buds. This is likely caused by hybridization between Japanese red pines *(Pinus densiflora)* and Japanese black pines.

Japanese black pines are a particularly vigorous species, especially in warmer climates such as their native Japan. They have two needles per fascicle, similar to most pines and show marked apical dominance and also dominance of branch tips. Japanese black pine, as with most temperate pine species, has a single spring flush of growth which, in a healthy plant is long and coarse and is generally removed in bonsai culture. Subsequent growth is finer in nature, produces an equal or larger number of shoots with smaller needles and is generally better suited for bonsai training.

Because Japanese black pine is so commonly grown and makes such outstanding bonsai more has been written about it than any other pine. Thus it is the model used for explaining "Pine Theory", which is understanding the physiology of candle emergence, of vigor distribution and finally, of how a pine responds to pruning at different times of the year. Other two and three needle pines of sufficient vigor respond similarly. Five needle pines and slower growing two and three needle pines are less vigorous and respond differently than

Japanese black pines to the removal of the spring growth. In this article any general, unspecified reference to pine tendencies should be assumed to be Japanese black pine unless otherwise noted.

This very famous Japanese black pine, Pinus thunbergi, *has been exhibited for many decades throughout Japan. It was originally trained from a young collected seedling.*

Refinement Techniques

The techniques addressed in this article are primarily designed to increase ramification and promote fine growth in pines. They are refinement techniques and as such weaken the trees temporarily. These refinement techniques were devised for use on trees in transition from the semi-trained state to bonsai or for show quality bonsai.

To reiterate, these techniques are designed for trees that have preexisting nebari, (lower trunk and surface root region), trunk girth, defined trunk movement, taper, defined primary branches and are growing in a container. Using these refinement techniques on stock plants, or in-ground plants will retard their progress. Plants in development (pre-bonsai) need deep boxes or in-ground growth. Use of unchecked leaders, multiple, basal sacrifice branches and repetitive top replacement techniques applied over multiple growing seasons is necessary prior to making the transition to a bonsai container. Only then should the grower begin to apply refinement techniques. It is very important to allow a period of wound compartmentalization and callus formation to occur before refinement techniques are applied or wound closure will not satisfactorily occur. Open wounds on a soft-wooded pine may significantly foreshorten the tree's life span.

ABOUT THE AUTHOR
Greg Cloyd

Greg Cloyd is a serious bonsai hobbyist who has studied pines for many years. He has organized an advance bonsai study group and invited many of the top pine specialists from the country for discussions and educational programs. The search for authoritative information on pine has recently led him to Japan where he visited many of the top growers.

Dr. Cloyd is a physician and member of the Cleveland Bonsai Club. He is also interested in native collected trees. He freely shares the results of his research and study by presenting programs and writing articles for publications. He maintains an impressive bonsai collection in Hudson, Ohio.