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Tree Pruning: What Do Trees Think?

Trees continue to survive despite the many challenges they face in the urban environment, but they need our help. We often place trees in less-than-favorable growing locations that don't allow natural development and maturity, locations where they often require pruning to develop into long-lived trees.

Guiding young and medium-aged trees to develop good branch architecture is key to sustainable tree plantings. Good architecture created through structural pruning is enormously beneficial and should be the primary objective for pruning. Helping the tree develop better architecture can reduce the chance for failure when nature gets nasty. This benefits the tree owner and the tree and should be the main reason we prune. The benefits of pruning far outweigh the negatives when done correctly—with the tree in mind!

Structural pruning on young trees help trees survive the urban environment.

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What Does a Tree Think of Pruning?

Most arborists and landscape professionals understand pruning as an important arboricultural practice. However, I don't believe we really understand what a tree "thinks" about pruning. Of course, a tree can't give a verbal opinion. Pruning elicits some incredible reactions on the insides and outsides of trees—and that says a lot. Because pruning is an important practice for arborists and landscape professionals, it is critical that we know these reactions and outcomes of pruning before we begin the process.

It is impossible to talk about pruning without first mentioning the importance of tree selection and placement. We should plan and plant by "beginning with the end in mind." "Right tree, right place" is an important concept for tree longevity. Focus on sustainability and maintenance inputs, which include reducing the need to alter the tree to conform and allowing the tree to realize its natural form and function. Simply stated, make efforts to minimize the inputs and maximize the benefits trees provide.

So, what do trees think of pruning? Well, let's start with the facts that pruning intentionally:

- wounds the tree in multiple locations,
- removes food production capabilities,
- creates a hormonal frenzy and
- potentially alters stability of the tree.

That's quite an effect for a process that's perceived as "simple." At the very least, we are modifying the physiology and morphology of the plant when live, green tissue is removed. At worst, the loss of food production and reserve capacity from excessive pruning can devastate the tree. In either case, pruning live tissue limits tree processes, because there are fewer shoots, a lower carbohydrate supply, less storage, and less nutrient uptake. This can lead to decline and dieback in the tree and predisposition to pest and environmental issues.

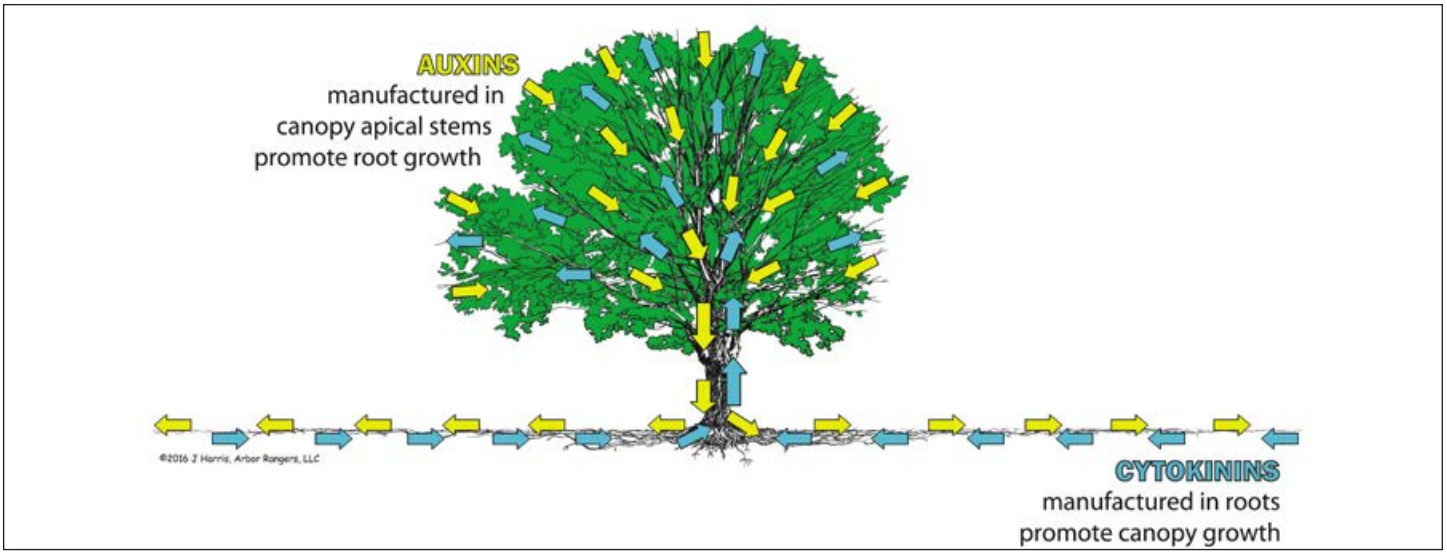
Properly selected branch cuts influence tree response.

Pruning Disrupts Chemical Routes

Let's take a look at that hormonal turmoil. All aspects of tree growth and development are regulated by phytohormones (plant hormones). They are chemicals that are often produced at one location and translocated to another where they go to work. Pruning trees creates a disruption in the flow or routes for the many chemicals found in trees. These long, connected pathways not only transport food and water, but also phytohormones tell trees how to respond when pruned. There are several major hormone groups, which include auxins, gibberellins, cytokinins, abscisic acid, ethylene, and other minor hormones. Through actions of these major groups, over 2,000 plant processes are affected!

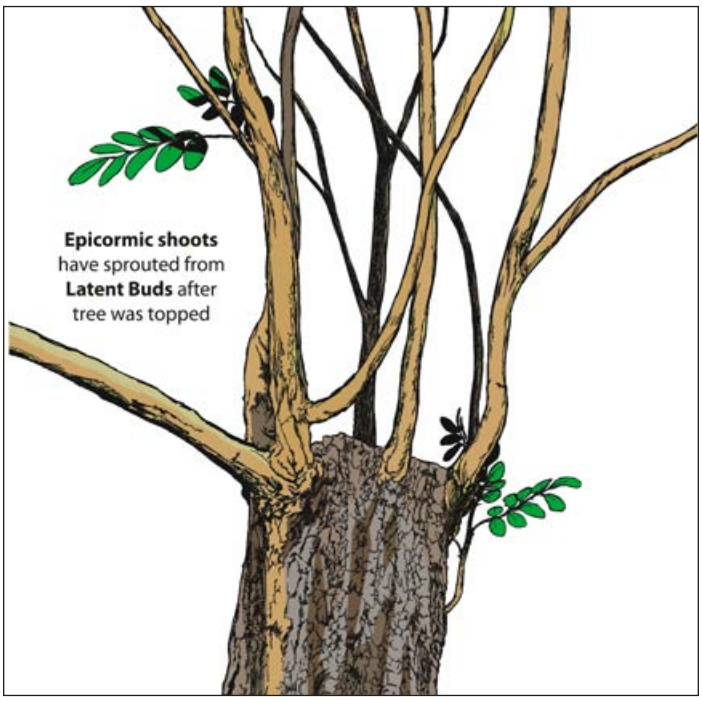
Severing branches during the pruning process interrupts or disconnects the chemical pathways that influence root and shoot growth, the auxin-cytokinin pathway. The downward flow of auxins, which are produced in the green shoot tips, stimulate root and shoot growth. The cytokinins produced in the root growing-tips stimulate canopy growth. Cytokinins produced in roots promote the activity of lateral buds, while auxin produced in the apical meristems and new foliage inhibits cytokinin activity through a process called apical dominance. Branch buds are initiated in the shoot apex, their flushing activity activated by cytokinins.

Pruning cuts that remove growing tips disconnect auxin-cytokinin pathways in the tree. Shoot tip removal releases dormant growing points such as lateral and epicormic buds. These unseen dormant buds move outward with the vascular cambium as the tree grows and remain close to the surface. So, when something such as removing branches happens to interrupt the pathway, buds may emerge and grow into branches, attempting to restore the pathway from the released sprouts to the ends in the roots. Typically, a proliferation of lateral buds develops into branches below the the location of the pruning cut where the apical meristem on the branch was removed.



Pruning live, green tissue has an impact on the auxin-cytokinin pathway.

Basically, the cytokinins follow the established route until the top of the branch is removed through pruning. When that happens, the tree thinks, "Where did those branches go that once connected us all with the roots?" Now, due to the missing shoot which produces auxin, the latent buds on the truncated branches break dormancy; develop new stems; and produce new, weakly attached shoots. The concentration of cytokinins increases, flushing new growth below the location of the cut. Also, all this new growth requires resources to survive, such as food and water. This newly formed expansion of growth is often at the expense of the root system and overall health of the tree as the allocation of resources has changed dramatically. It's a delicate balance of chemicals!



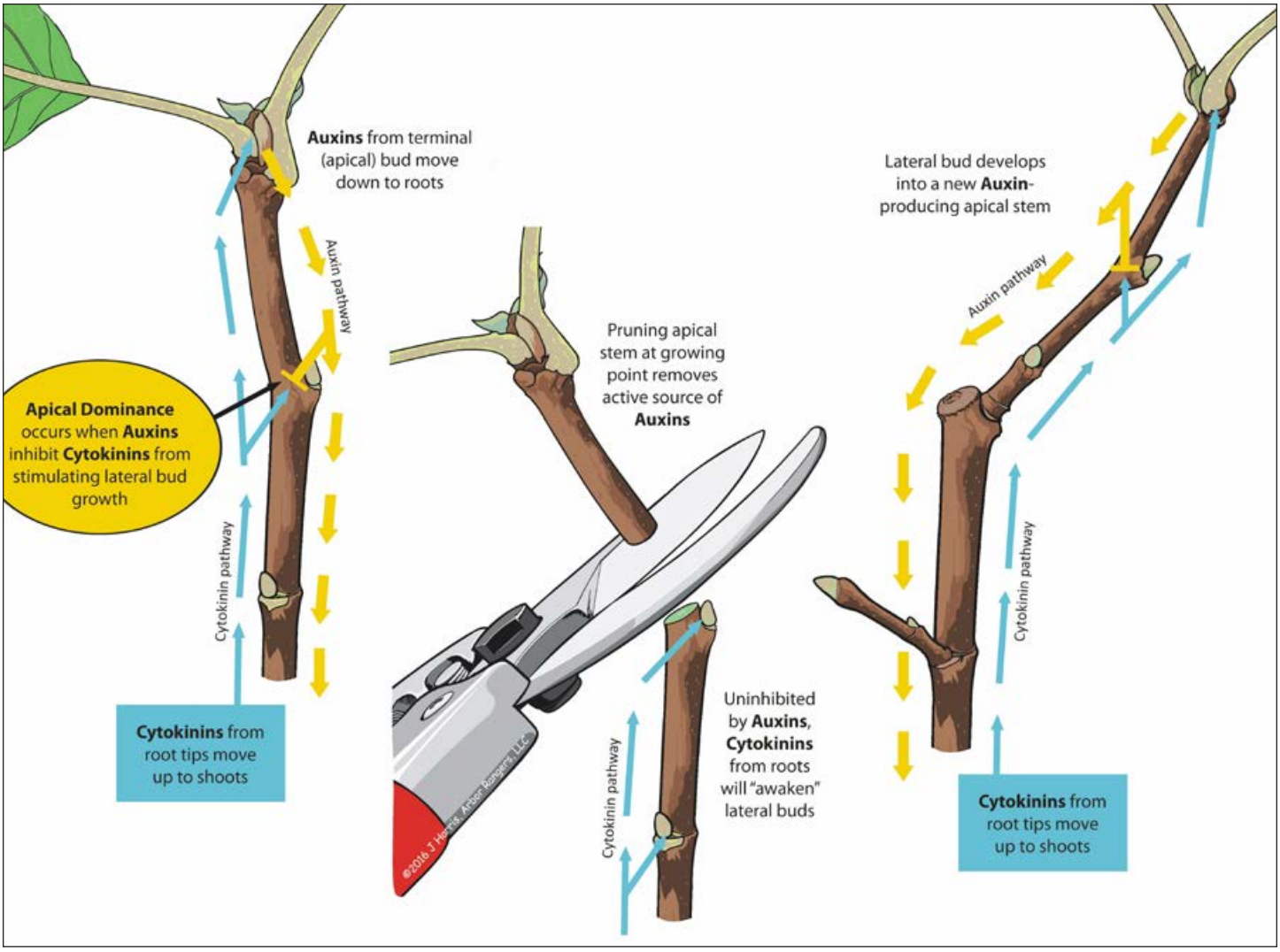
Weakly attached sprouts are prone to wind and ice damage.

Pruning Disrupts Apical Dominance

Apical dominance varies within tree species and influences plant shape, length, and number of lateral shoots. Trees with strong apical dominance are more upright in growth (excurrent crowns). Those with weak apical dominance have more horizontal and spreading growth (decurrent crowns). Pruning can alter the shape and direction of growth of both by manipulating branching habit and influencing the hormones involved in growth.

The apical buds in the tree structure produce auxins that are actively translocated down the shoot. As the auxins pass the lateral buds along the shoot, the buds maintain dormancy and are unable to sprout and grow. If the growing tip is still there, auxins flow and these lateral buds remain dormant. However, if the growing point is removed, auxin production is interrupted. This interruption allows the cytokinin present in the stem to activate the growing points and allows flushing of new growth and lateral branches. Heading back or making reduction cuts on an excurrent tree form can alter the natural shape of the plant.

Pruning is about controlling branching and growth. However, many people overlook or fail to understand that when we prune, the hormonal balance is altered and new branches develop locally, close to the cut. Excessive removal of green tissue significantly alters the phytohormone balances, disrupts photosynthesis and carbon balances, which is how the plant feeds itself, and can result in decline or even death.



Pruning influences direction of growth by releasing new branch growing points.

Minimize the Damage, Maintain Balance

Dr. Shigo once said that to be a good arborist, first, you must know your tree. This includes knowing the health, vigor, and stage of development before you determine the pruning dose or the amount of green tissue removed during any one pruning episode. Removing dead, damaged, or dying tree parts or non-beneficial plant parts such as basal sprouts or epicormic sprouts doesn't figure into the mass when calculating pruning dose. However, severe pruning, especially at times of stress such as during drought conditions, can have severe consequences on tree health. You want to use the pruning dose that has the least negative impact on tree processes.

Intentionally wounding the tree sounds counterintuitive to what we, as arborists, want to do in maintaining healthy, long-lived trees. However, it is often a necessity to get trees and people to get along well together. But, we certainly are wounding a tree when we apply pruning tools to the task. The tree's response when wounded is critical for survival and plant hormones are involved in wound recovery. Many phytohormones are necessary for cell division, which facilitates compartmentalization. The compartmentalization of decay in trees (CODIT) process is an important tree strategy for surviving the damage of pruning maintenance. Walls are developed internally and wound wood is created externally which "compartmentalize" the wound by sealing off the damage and making efforts to prevent decay from moving further into the tree. Trees have varying abilities to seal off these wounds depending upon species, health, conditions, and their resource allocation strategies.

Proper pruning cuts allow trees to seal wounds quickly.

At this pruning cut the tree effectively sealed the wound.

How would a tree react to activity that could reduce its ability to remain vertical and withstand the forces of nature? Most likely by losing balance and falling! Trees are large, heavy structures subject to both static and dynamic forces. Any significant changes or modification to the canopy can result in a response from the tree that changes its biomechanics. After alteration, the once stable and safe canopy may be prone to failure during wind and storm events. This has serious implications for practices such as crown thinning, lions-tailing, and topping of canopies.

Improperly pruned trees can make trees unstable and could fail in high winds.

The bottom line is, if you don't know what you are doing when pruning, it is best to leave trees alone. Removal of large structural branches or large amounts of green tissue can and does have an impact on the trees' ability to withstand wind loading and other environmental forces.

Timing Is Everything

Current research has helped tremendously in determining the optimal times to prune to reduce the impact on the tree and facilitate faster wound recovery. If we want the trees to think better of our wounding activities, we should prune when the trees recover the quickest. This is when they are actively growing and their internal processes are functioning best during their growing season. Also, get to know which trees facilitate wound recovery more effectively. Some trees are considered good compartmentalizers; some are not so good at the process. This will help with the decision-making process on size of branch removal and amount of green tissue to be eliminated.

Finally, when making the pruning cuts, smaller wounds are always better for the tree. It has been said many times that pruning is one of the "best worst" maintenance practices, but a necessity in the built environment. Working with the tree to minimize the impact of this practice should be a priority for the planner, designer, and arborist. This includes abiding by the physiological demands of the tree. Do it right, at the right time and in the right way when pruning. Never let the situation exceed your skills. Ill-advised pruning cuts and poor timing can create serious concerns for the life of that tree and everything around it.

Good pruning cut selection creates a sustainable tree structure.

Resources

Dr. Edward F. Gilman, Professor emeritus, Environmental Horticulture Department, IFAS, University of Florida.

Shigo, A.L., and Marx, H. 1977. Compartmentalization of decay in trees. (CODIT)

Dr. Kim D. Coder, Professor, Warnell School of Forestry, University of Georgia

Illustrations by Jeff Harris, Arbor Rangers LLC.

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