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Sunlight and Plant Hormones

Hi Folks. Generally I try and steer clear of the technical stuff, but every now and again it is good to delve into the biology of trees and plants in order to understand them better, enabling us to produce better bonsai.

Plant cells don't just reproduce wildly like cancer, they develop according to signals that are transported around the plant by hormones. Auxins are a family of hormones that control just about every growth function in a plant, and the most important of these is called Indole Acetic Acid (IAA). They make plant cells grow longer which enables them to split and reproduce. They do this by making the cell walls more elastic at the ends. This allows them to absorb more water and to stretch like sausage balloons. Auxins are produced in areas called meristems. Apical meristems are at the growing tips in the shoots, and at the very ends of the root tips, and they are the primary area for cell production in plants. Lateral meristems occur in the cambium throughout the plant and these are responsible for thickening the tree through lateral growth.

One's initial reaction is to the existence of auxins is to presume that more "growth" is good, but this is not always correct. In actual fact, when scientists talk about "growth" in plants they are talking about cell development minus water content. So, in theory, to measure a plant's size accurately one would have to kill it and dry it out until all the water has been removed. This is not something one would actually do, but it is important to understand the idea that to miniaturize a tree is essentially a process of miniaturizing the cells through reducing the amount of water the cells absorb. As bonsai people we don't want long tall trees, we want our bonsai to grow in width. We want cells with low water content resembling biltong rather than lettuce. Long thin cells with a high water content are very weak, and have no added value when it comes to bonsai.

The good news is that all one has to do is make sure the tree gets lots of sunlight because sunlight eradicates or destroys auxins. When the auxins are reduced a second family of hormones called Gibberellins are able to affect the plant. These gibberellins make the cells grow equally in all directions, which is good because the result is that the tree now grows in width (and height) with well-formed cells.

The combination of the auxins on the shady side of a tree and the gibberellins on the sunny side cause the tips of shoots to grow toward the sun. This is called positive phototropism. Auxins in root tips do not have a well-defined directional light source to react to so they encourage the root tips to grow downwards, but because the soil in bonsai pot is not too deep, the roots will still grow more strongly away from the sun. This is negative phototropism. There are two not-so obvious lessons for the astute gardener here. One, plants in pots should be periodically rotated in order to face a different side of the plant to the sun, otherwise they may grow lopsided with better foliage on the sunny side and stronger roots on the shady side. Two, roots will not develop very well in containers that allow sunlight through. Use dark coloured and opaque containers for propagating cuttings.

The eradication of auxins by sunlight has a profound affect over the seasons as well as just over the period of a day. During spring and summer the small quantity of auxins in the cambium (produced by the lateral meristems) throughout the tree prevent the leaves from falling off. The shorter autumn days means less photosynthesis and consequently fewer auxins are produced. This allows a layer called an abscission layer to form around the stalk of leaves and fruit. The abscission layer weakens the connection of the leaf to the branch and it eventually drops off. This is called Leaf Abscission but is just a fancy way of