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The Myth of Stoic Trees

"Unless it causes visible damage, touching or brushing has little effect on plants"

The Myth?

For those of us whose vocation or avocation includes sustainable management of landscape plants, one of our core tenets is basing our practices on scientifically objective criteria. This column has tried to bring some of that science to practitioners and has also identified some of the questionable practices and products with no basis in science. Therefore, informed professionals and gardeners alike are rightly skeptical when they hear that plants respond to touch. Of course, damaging forms of contact with plants, whether by herbivores or construction equipment, will elicit a response from plants. But plants responding to gentle stroking is a little too "touchy-feely" for many of us. Is this science or pseudoscience?

The Reality

Plants, being immobile, have responses to their environment often quite different from organisms that can escape unsuitable conditions. Therefore, plant responses to touch (often termed mechanical perturbation or MP in the scientific literature) can be exquisitely sensitive. The ability of some carnivorous plants to actively trap food is an example of touch response, as is leaf movement of sensitive plants (*Mimosa* spp.), and coiling of vine tendrils. These are relatively rapid responses compared to another type of touch response called **thigmomorphogenesis**. This word was coined several decades ago by one of the first researchers in the area, and is used to describe more long-term changes in the appearance of a plant ("-morpho-") in response to repeated touching ("thigmo-").

Thigmomorphogenesis can be induced by many types of environmental MP including wind, water spray, snow load, and rubbing from other plants. People, wild and domesticated animals, and even insects can also cause these changes. The responses are species-specific in terms of the amount of MP required and in the morphological changes seen. Initially studied in annual crop plants, such as peas beans, corn, and sunflowers, MP was universally seen to decrease stem elongation and increase stem thickness. Other characteristics include shorter petiole length, decreased needle elongation, smaller leaves, reduced flower number, and increased senescence (programmed tissue death). Similar responses have been demonstrated in woody species including pine (*Pinus*), spruce (*Picea*), fir (*Abies*), poplar (*Populus*), and elm (*Ulmus*).

Continual rubbing or brushing of woody trees and shrubs, even that which is gentle enough not to abrade tissue, will result in shorter heights and wider trunks. This is partially meditated through the release of ethylene gas, a naturally produced plant growth regulator, which in turn increases the formation of lignin in the disturbed tissues. The result of thigmomorphogenesis is a stocky, sturdy plant that is more resistant to breakage or windthrow than one that has been untouched, and the greater the disturbance the more pronounced the response. The short, stunted appearance of alpine forest trees is an extreme example of wind-induced thigmomorphogenesis. Such trees are less likely to break from snowload or suffer windthrow than thin, upright specimens.

For a research plant scientist, understanding this phenomenon is crucial in executing successful experiments. The simple act of measuring a plant's height, or a leaf's length, is itself an experimental treatment. The more a plant is handled during measuring, the greater the thigmomorphogenetic response will be. Therefore, researchers must be extremely careful to handle all experimental plants in an identical fashion for an identical length of time, or they will confound their experiment through differential MP responses. Even if plants are handled in a controlled manner, in some field studies this has resulted in increased herbivore damage from insects that hone in on the ethylene and other gases emitted by plants under stress.

For installers and managers of landscape trees, thigmomorphogenesis is especially important to understand. While trees in the middle of a forest do not experience buffeting from wind, urban trees are more likely to be isolated and exposed. Allowing these isolated trees to sway in the wind will increase their trunk girth and taper while keeping crown growth in check. Wind stress also increases root growth and stability, especially in shallow or compacted soils (common in urban areas). The result is a more firmly anchored tree with a reduced crown-to-root ratio. In contrast, trees that are staked too tightly or for too long cannot sway in the breeze and therefore do not develop the girth, taper or root stability necessary to surviving future wind stress. They are, however, taller and thinner with greater crown development. Such trees are more likely to experience crown breakage or uprooting once the staking is removed (Figure 1).

Figure 1. It only took one good breeze to break the crown of this oak once staking was removed.

The Bottom Line

- Plants exposed to continual touching by various environmental factors undergo thigmomorphogenic changes.
- Easily seen thigmomorphogenic changes in landscape trees include increased trunk diameter and decreased height.
- Researchers must be aware of the thigmomorphogenic changes plants will experience as a result of being handled during experimentation.
- Improper staking of urban trees will inhibit normal, wind-induced thigmomorphogenesis and these trees are more likely to topple or break once staking is removed.

For more information, please visit Dr. Chalker-Scott's web page at http://www.theinformedgardener.com.