Fertilizing Stressed Plants

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As growers, we all know our most important tool is our eyes. We are always observing and analyzing growth patterns, color of plants, abiotic and biotic plant damage, and stressed plants in order to produce the healthiest, most vigorous plants possible. The belief has long been that the strongest, healthiest plants were the plants with a vigorous growth rate. We have long emphasized fertilization with nitrogen in order to improve the plants growth and equated this with plant health. However, a fast growing plant doesn't always withstand the stresses of the homeowner's environment.

Dr. Paul J. Kramer, the noted plant physiologist, stated in 1956, "We will learn how to grow trees by learning how trees grow". Dr. Kramer is stating we can't just depend on our eyes to grow healthy plants, we need to understand what occurs within the plant that allows it to grow and survive. When we take a look into the plant's physiological mechanisms we will find that fertilization will often limit a plants natural resistance to environmental stresses.

Dr. Daniel Herms, our research entomologist at The Dow Gardens, has addressed through his research many questions regarding current fertilization practices and the effects nutrients have on the plant's ability to withstand stress. Dan has found that fertilization encourages growth but decreases in secondary metabolite production. These secondary metabolites defend the plant against insects and diseases, attract pollinators, protect the plant from U.V. light, provide structural support, act as temporary nutrient storage, regulate phytohormone activity, promote drought resistance, help facilitate nutrient uptake, and mediate plant relationships with symbiotic nitrogen-fixing bacteria. These metabolites are termed secondary only because they are not direct products of photosynthesis. As one can see, the health of the plant is very dependent on these metabolites.

There is strong evidence that fertilized trees have lower concentrations of secondary metabolites and thus are more susceptible to insects and diseases, as well as abiotic stress. It is well documented that succulent growth is susceptible to sucking insects (i.e. aphids, scales, leaf hoppers, and spider mites), and diseases (fire blight), with decreased winter hardiness and structural support. Other studies confirm fertilization increases growth but with a trade off in terms of decreased insect and disease resistance. A study on the gray willow (*Salix cinerea*) showed fertilization increased growth, with decreased concentrations of starch, lignin, tannins, and reduced resistance to a leaf-feeding beetle (*Galerucella lineola*). In other studies fertilization increased growth of Yukon white birch (*Betula neoalaskana*) and quaking aspen (*Populus tremuloides*) and decreased their concentrations of defense compounds, lowering resistance to snowshoe hares and leaf feeding insects. Balsam fir (*Abies balsamea*), grand fir (*Abies grandis*), and loblolly pine (*Pinus taeda*) have all shown increases in growth and a decreased resistance to insects in response to fertilization. When there are high levels of water, sun, and nutrients, secondary metabolites seem to take a back seat to growth.

Those who grow plants in order to utilize the secondary metabolites for profit have long recognized the value of growing plants under stressful conditions. Rubber trees

produce more rubber when growing slow, and in dry conditions Tobacco plants have higher levels of nicotine when growing in hot temperatures And let's not forget the *Cannibus sativa* which is more potent when grown under some stress

One can use the teeter totter to picture the effect fertilizer has on plants The more fertilizer one applies, the more growth but with a reduction of secondary metabolites and environmental resistance. Plants under some stress will have a reduced growth but will be more resistant to the environment

In evaluating the health and fitness of a plant, we may find that the vigorous, fast-growing plant may not best tolerate the homeowner's environment Rapid growth has its consequences: decreased production of natural defenses. These defenses are important for the survival and well being of the plants we are producing.

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