Root-Zone Electrical Conductivity Monitoring for Nutrient Loading and Spiking of Container Tree Seedlings

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Container planting stock is commonly reared in small plugs or cells with limited substrate volume relatively low in buffer potential and nutrient reserves. Consequently, root-zone nutrient status changes rapidly in response to cultural manipulations and crop nutrient demands. These factors are particularly critical under intensive fertilization since plants are sensitive to extreme alterations in nutrient supply. Thus, it is important to monitor root-zone nutrient status frequently during the growing cycle to track and maintain desired growing media fertility. Substrate electrical conductivity (EC), usually determined from a saturated media extract, is the standard method of assessing growing media nutrient status during container tree propagation. In this paper, we address the need for EC testing to optimize substrate nutrition under two intensive fertilization techniques that promote early outplanting performance of conifer seedlings. We also report on the press extraction approach as a rapid, low cost alternative for routine monitoring of root-plug EC.

Nutrient loading builds up reserves in seedlings by inducing luxury consumption of nutrients. This is often accomplished through exponential fertilization, whereby nutrient inputs match exponential plant growth. The enhanced reserves are tapped internally after outplanting, and more effectively meet growth demands than external soil pools often limited by supply and competition from surrounding vegetation. Forcing luxury nutrient consumption on nursery seedlings is controversial because of concerns of plant stress associated with high fertilizer application. Our studies demonstrate that substrate EC can be a sensitive guide for regulating fertilizer applications. Periodic tracking clearly distinguished between conventional and exponentially driven delivery regimes and various dose rates applied. Trends accurately reflected substrate nutrient build up from loading and subsequent decline with fertilizer withdrawal at hardening. Potential toxicities were identified in time for remedial practices that minimized crop stress.

Nutrient spiking replenishes root-plug fertility of container stock before planting. The plug serves as an important reservoir of readily available nutrients for newly planted seedlings. Plug fertility is high during nursery culture, but is severely depleted during hardening and storage when fertilizer is withheld. Refertilization after storage is risky because of stock sensitivity. However, carefully controlled “spiking” of root plugs with liquid fertilizer to target EC status prior to planting markedly increased field survival and growth without stimulating neighboring weeds. Transplanting trials revealed maximum root-plug EC spiking capacity as high as 4.5 dS/m. Post-transplant growth performance declined after this target level, but nutrient accumulation increased suggesting that inhibition was associated with interactions of nutrient excess and reduced moisture availability.

Electrical conductivity readings derived from press-extracted and standard vacuum-extracted substrates sampled across a range of fertility showed strong correlations ($r=0.96$) between the two procedures. A small adjustment for differences in saturation moisture conditions may be required. Press extraction employs a kitchen potato press to expel soil solutions from peat-based growing media, and operationally offers a simpler, quicker and inexpensive approach to plug EC monitoring compared to standard laboratory-oriented vacuum extraction methods.