Nursery Crop Science
College of Agriculture and Life Sciences • NC State University

What's Quality for a Plant Grown in a BIG CONTAINER?

Ted Bilderback
Nursery Crops Extension Specialist

Do you know quality when you see it? What are the characteristics that bestow perceptions of quality to landscape trees and shrubs grown in containers. Are the perceptions of quality the same for everyone, for example, landscape and nursery professionals compared to home owners?

Research has shown that professionals and consumers tend to think alike. Both groups prefer symmetrical round or conical shapes versus asymmetrical lopsided shapes for most container plants used for traditional functions in the landscape. Shrubbery with full compact canopies without obvious structural defects, openings, damaged branches, off color foliage or sparse growth are preferred. Most perceptions related to quality also suggest that plants not be root bound, however this quality is seldom investigated until they are planted in the landscape.

Large container grown trees are frequently the most expensive plant material used in new landscapes and the most expensive for growers to guarantee and replace. Therefore, the first measure of quality is how well the roots grow and become established after it is removed from the container. The growers responsibility in landscape establishment is to sell a well developed root system, distributed throughout the container. To accomplish a quality root system, the grower must make the right choices of potting substrate, fertilizer strategies and irrigation.

The potting substrate for 15 gallon and larger containers is most often a pine bark : sand potting mix. Ratio's of 6:1 or 8:1 pine bark : sand are popular. Sand as a potting mix component adds weight, and provides anchorage to reduce blow over from wind gusts. Beyond anchorage, the major role of container substrates is to provide a reservoir of water and nutrients for root absorption, plant survival and growth. A red maple with a large canopy in mid summer can easily utilize all of the available water in a 15 gallon container. Analysis of physical characteristics of a 6 pine bark: 1 sand (v/v) potting mix consistently indicates that approximately 30% to 35% of the volume of the substrate is available water content. Therefore, at least 5 gallons of water may be required per container to avoid water stress on a hot day in July for a crop of red maples. Deciduous crops tend to have the highest water requirements during the growing season, followed by broad leaved evergreens and then conifers, however there are many exceptions and each crop may require it's own irrigation strategy based on the moisture retention characteristics of the potting substrate. One criticism of pine bark and sand substrates is that they have high aeration characteristics and hold too little available water content. However, many experiments have illustrated that substrates with high air space characteristics and less water holding capacity produce larger plants than substrates with high water holding characteristics and limited air space, if irrigation is not limiting. Therefore, if irrigation is applied frequently such as would be practiced with cycled irrigation, rapid plant growth is expected.

Some growers are experimenting with addition of 5% to 10% soil (by volume) to pine bark for growing large container plants. Soil may not increase weight as much as sand however, increased available water content and nutrient retention may result. The key to adding soil will be increasing moisture retention without limiting aeration in the substrate and using irrigation practices that coincide the substrate. Traditionally, if soil is used in potting substrates, it should be sterilized to reduce disease, nematode and weed infestation problems. A possible alternative may be to mine soil well below topsoil layer. Soils from the B-horizon, harvested 6 feet to 10 feet below top soil might be less likely to be infested. There is great variability in the chemical and physical characteristics of B-horizon soils and their contributions to potting substrates will vary from location to location. Experiments are underway at N.C. State on use of commercial soil products with known particle size and chemical characteristics as soil additions to pine bark substrates. Results of these studies can be compared to other experimental studies with various B-Horizon soil : pine bark combinations. The intent of each study is to determine the potential for use of soil as an ingredient in larger container potting substrates. Ultimately, striking the right ratio of aeration and moisture retention matched to the irrigation will be necessary for success.

Overhead sprinkler nozzle irrigation is a very inefficient method to apply water to plants in large containers. Much of the water from sprinklers is deflected by the canopy of container plants and does not enter the container. This practice leads to dry spots in the potting media and eventually hydrophobic conditions in the substrate that shed water rather than absorbing water. Ultimately, poorly distributed root systems develop in the containers. Irrigation of large containers is most efficient using low volume / low pressure spray stakes. Spray stakes with application rates of 5 to 15 gallons per hour are preferable to drip or trickle nozzles with flow rates of 1 to 5 gallons per hour. Drip or trickle nozzles simply cannot supply water fast enough to replenish up to 35% of the container volume each day. Irrigating containers using multiple applications throughout the day (cycled irrigation) is a good irrigation strategy. Multiple irrigation cycles maintain near maximum available water content and assist crops to continue growing rather than closing stomates and undergoing water stress. Container plants in 15 gallon size and up generally benefit from more than one spray stake per container for two reasons. First, water distribution is frequently blocked by the stem of the plant creating a dry spot opposite the stem. Secondly, water movement laterally across pine bark media in the container is very limited so only the column in the spray stake pattern is sufficiently moistened. Distribution of irrigation water for thorough irrigation has a great influence on the quality of root system developed in the container.

Growers need to ensure that 13 essential nutrient elements are available for plant growth. However, some nutrients may be provided in sufficient quantity by irrigation or from the substrate. For example, irrigation supplies frequently contain significant amounts of calcium and reduce or replace calcium supplied by the addition of dolomitic limestone. Secondly, if soil is used as a potting component, supplementing the substrate with a minor element product may not be necessary. A complete laboratory nutritional analysis of irrigation water and the substrate is necessary to determine what nutrients need to be supplemented for optimal plant growth.

Most growers producing plants in large containers use controlled release fertilizers (CRFS) for at least part of their fertilizer program. CRF's can be applied in one or combinations of four application techniques. Incorporation of CRF's at potting is an efficient means of getting distribution of the fertilizer throughout the potting substrate, however this practice may be limited to nurseries with mixing equipment. A second method might be to fill part of the container with potting mix, add a layer of CRF, place the plant into the container and continue filling the container to finish planting. Surface application or topdressing CRF can be used as the only application technique or it can be used in combination with the layer method or as a means of re-applying fertilizer to containers incorporated with fertilizer. A fourth application technique might be described as drill and fill or punch bar technique where a column or columns of CRF is applied adjacent to the root ball after drilling or punching a hole in the backfill of the container mix. In addition to CRF application, soluble liquid fertilizer application can be applied through the irrigation nozzles as a supplement or as the sole nutrient application practice.

The pool of nutrients available for adsorption and subsequent growth of container crops must be soluble and contained in the liquid solution held by the container substrate. For a grower to understand the nutrient status, this liquid solution must be extracted and analyzed. Obtaining liquid solution or leachate from large containers is a greater challenge than using the Pour Thru Extraction Technique, since it is difficult to lift the container and collect leachate from drainage holes. However, equipment is available for extraction of solution from large containers. Soil water samplers, called suction cup lysimeters, are available for extracting nutrients from large containers (5 gallon and above). The samplers are installed to the bottom of the container and left in place for periodic sampling of the water in the container. The sampler consists of a porous ceramic cup attached to the bottom of a sampling tube. One to two hours following irrigation a vacuum pump is used to create a vacuum in the sampler, which draws water from the container through the ceramic cup and into the sampler. Adequate water collects in the sampler in 5 to 10 minutes which can be withdrawn with a syringe for subsequent EC, pH or a complete nutrient analysis. Three or four water samplers should be installed within a block of plants of similar size and nutrition. Additional information, cost and information to order suction cup lysimeters can be found at the following webpage: http://www.soilmoisture.com/horticulture.htm

Irrigation practices, nutrient application strategies and characteristics of container substrates are inseparable regarding their influence on development of the hidden indicator of quality; the root system of plants grown in large containers. The ability to manage all three in concert determines how successful a grower will be in bringing crops to sale and satisfying customers on their performance after sale.

The top of the plant, the canopy is the obvious visual indication of quality. Knowledge of pruning, staking and training are necessary to produce highly aesthetic nursery crops. Broadleaved evergreen and coniferous evergreen crops are usually sheared frequently up to 3 to 7 times during the growing season to produce a dense branching structure. All growing tips are removed with each shearing. For conical shaped plants. a single terminal leader is encouraged to grow upward several inchesthen the tip is removed to stimulate branching. A new single terminal shoot is then again selected to grow upward and other shoots are pruned back several nodes to a node with a bud on the bottom side of the branch or to a small branch with an orientation to grow outward and down rather than upright. Stakes taller than the leader attached to the main stem are frequently required during the first few months of production while anchorage of the root system occurs and to encourage upright growth of the plant. Stakes should be removed before the leader out grows the height of the stake, otherwise the leader will grow away from the stake and become mis-shaped. Be certain to remove stakes within the first growing season or damage may result to the leader and at points where the stake is attached to the main stem.

Pruning single leader trees such as red maples or oaks to preserve the leader and maintain a single dominant leader is an entirely different approach than described for shrubbery. The pruning philosophy for pruning single leader trees is very selective. Initially, the height of the canopy or where the first permanent branches will be set, is determined by the size of tree to be grown and the potential market for which the tree is being developed. Trees grown to 2.5 inch caliper in a 25 gallon container may have a head height set at 60 or 72 inches, while a 1.5 inch caliper tree in a 15 gallon container may have a head height of 48 or 60 inches. Small twigs can be left on the lower stem of single leader trees during the current growing season to stimulate growth in caliper in Fall, however twigs should be removed before they reach a diameter of over 1/4 inch, otherwise a larger wound than desired. Branches within in the permanent canopy are selected for wide angles of growth and branches with tight angles of growth are removed. Branches on the same side of the canopy that are growing in the same direction are selected to have at least 6 inches minimal distance spacing on the trunk, with branches giving the appearance of spiraling as one looks from the ground into the canopy. Occasionally, the main terminal leader is lost or removed. To develop a new leader, a bud or twig can be selected. Potentially competing buds or branches are removed or significantly pruned back. In the case of choosing a bud to become the terminal, a strip of masking tape can be attached to the stem opposite the bud and a tunnel or tube formed around the bud to direct it straight upward as it elongates and becomes the new terminal. If a lateral twig is selected as the terminal, a short support stake can be tied to the terminal to form a splint to pull the twig upright or if a terminal still is present, all buds and shoots can be removed and the remaining stick used to act as a splint for attaching masking tape in two or three places to pull the lateral twig upright. In any case, the masking tape will deteriorate after it has served it’s intended purpose. The most important quality characteristic for single leader trees is that a single dominant leader be maintained throughout the height of the tree. The Florida Standards for Quality grade trees based upon their height with a single dominant leader. Branch spacing and angles of lateral branches are also important quality characteristics in the Florida Standards.

Other specimen ornamental and flowering trees are grown as standards, with a single stem without branches to a specified height, such as 5 feet and then several main scaffold branches are selected as a canopy over the next two to three feet of height to yield an inverted umbrella like appearance. Branch selection and spacing follow steps as described for single leader trees.

Quality of plants grown in large containers are first assessed by their appearance, as seen through their symmetry, structure and line, dense canopy and color of their ornamental characteristics including bark, flowers, fruit and foliage. For plant professionals, quality characteristics extend beyond appearance to the distribution and fullness of the root system and the ability of the roots to grow rapidly and become established in the landscape.