Physical Property Measurements in Container Substrates: A Field Quantification Strategy

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Significance to Industry: Although conducting “home remedy” analysis of physical property results is not expected to be as precise as laboratory analysis, weighing drained containers and measuring drained pore space volume at grower sites can provide evidence related to differences in batches of potting substrates with excessive moisture retention or excessive aeration characteristics. Determining drained pore space (air space), using the simple procedure outlined here can provide useful insight into how to manage irrigation of crops having drainage or aeration problems and possibly into diagnosis of how to make changes to avoid future problems.

Nature of Work: Plant nurseries in the southeastern United States need a container substrate that does not waterlog after frequent rains over a period of several days. Under such conditions a substrate must provide excellent drainage and aeration capacity to avoid plant disease and death associated with fungal pathogens and/or excessive moisture. For nearly half a century the medium of choice in many areas has been screened pine bark.

Depending on the crop, container size, grower practices, and irrigation resources, growers may add sand or gravel screenings to the bark to improve water retention and to provide sufficient weight to the container to reduce blow-over. Growers receive bark inventory from bark processors. Processors may provide a bark and sand mix or growers may blend components themselves.

Variation in bark supplies occurs in relation to how it has been handled at the bark supplier’s location. Some bark supply companies turn and moisten inventory piles during an aging process; other bark supplies may be considered fresh inventory with little aging before processing and shipping.

The moisture content of pine bark at the time of processing also affects particle size. Dry pine bark moves rapidly through a hammer mill and will have fewer fine particles compared to moist bark that tends to clump together and stay in the grinder longer creating more fines during processing (unpublished data). Consequently, when the bark is received from the processor, the range in particle size may vary from one delivery to the next. Since particle size directly affects the substrate’s aeration and water retention (3), bark age and quality may dictate changes in a nursery’s irrigation regime.

Experienced growers develop a sense of how a bark mix will perform and how they need to handle it in order to insure good crop response. Even experienced growers, however, can misjudge the "feel" of the bark or overestimate the capacity of employees to judge how to handle the bark. If growers have the space and time to submit bark samples for laboratory analysis, they may have better data on which to base irrigation decisions. But routine laboratory analysis has not been sufficiently convenient.

Growers could benefit from a field strategy for comparing one delivery of bark to a previous delivery in order to make quick decisions about how to manage irrigation. However, procedures for field methods to compare potting materials have been complicated, confusing, difficult to perform, and highly variable in results. It is our objective to develop procedures and identify specific measurements that would be useful for comparing potting components and potting mixes on site at nurseries.

In this demonstration substrate from three bark piles at two nurseries were compared: two were 100% pine bark (nursery bark 1 and nursery bark 2) and one was a 90:10 mix of bark and sand (nursery bark:sand). These were then compared to standards determined in laboratory analysis (1). For ten replications of each substrate, one gallon trade containers were filled over the top then scraped to remove excess level with the top. Each container was tapped three times to settle. Containers were irrigated thoroughly and allowed to drain for thirty minutes. Containers were weighed for calculation of an average wet drained weight.

In a second demonstration, replicated ten times for each of the three nursery media, drained pore space was determined by lining containers with a plastic bag. Containers were filled with media and tapped to settle as above. Water was slowly poured over the media allowing water to infiltrate into pore spaces. Water was applied until it just covered the surface of the media. Saturated containers were placed in buckets or trays and holes punched through all the container drain holes into the plastic bag. Water drained from the containers was measured. Since each ml of water equals one cc, then the volume of water drained from the saturated container equals the volume of air space in the media.

The data from these field demonstrations were compared with ten replicates each of the same media analyzed by the NCSU Porometer procedure at the NCSU Horticultural Substrates lab (2). Data were analyzed using Analysis of Variance and Duncan's Multiple Range Test and are significant at P = 0.05.

Results and Discussion: Field methods can not be as precise as laboratory analysis, and they were not. Field data differed significantly from laboratory data in most cases (data not shown). It was not the objective, however, to provide data sufficient for research purposes. Our objective was to develop procedures and identify specific measurements that can be useful on site at nurseries using materials likely to be available. Since current laboratory data have little practicable application for field use by nurseries, we view these measurements as a beginning point for developing numbers that nursery operators can use. To that end, the numbers in Table 1 are provided only to give a point of comparison with averages of hundreds of samples, developed in the Horticultural Substrates Lab (1). Nurseries must be aware that the substrates they use are seldom average. For their purposes, numbers that they develop on site may prove more useful for comparing a new bark supply with a previous supply.

The procedure for weight of drained containers can also be used to compare potting practices among potting crew members. If newly potted containers have more than 10% difference in weight, the results suggest that potting practices need to be examined to determine if filling and planting practices are uniform among potting crew members.

Table 1. A comparison of air space percentage in 3 substrate supplies at two nurseries with laboratory analyses (1) for fresh and aged bark and bark sand mixes.

Substrate	Nursery bark 1	Nursery bark 2	Nursery bark:sand	fresh bark, Lab	aged bark, Lab	fresh bark + sand, Lab	aged bark + sand, Lab
Air Space	34%	32%	26%	42%	31%	31%	27%

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