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Avoiding Container Substrate Compaction

This e-GRO Alert includes information on the detrimental effects of substrate compaction from stacking or nesting containers on top of each other prior to planting.

To save time and labor, many growers often prefill and stack propagation trays, containers, and hanging baskets. However, if you prefill your containers, remember to avoid stacking or "nesting" them on top of each other on pallets or carts (Figures 1, 2, and 3) or intentionally compact the substrate with your hangs.

Why is this important? When containers are filled with substrate and stacked, substrate compaction can occur from the weight of the containers nesting within each other (Figure 4). The compaction of the substrate alters the packing density and physical properties (air space, container capacity, total porosity, and bulk density) of the growing substrate.

Figures 1 and 2. Compaction of container substrate can occur from "nesting" containers and trays on top of each other.

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Research at the University of Florida indicates that as compaction increases, there is a higher "dry bulk density" of substrate (more solid) in the container. Dry bulk density is basically the weight of dry substrate in grams per liter of volume. When the substrate is compacted, air space and total porosity is decreased by 50% or even eliminated, which ultimately means less drainage or the ability for the substrate to retain more moisture. Less drainage can lead to overwatering and an increased risk of root diseases. Furthermore, substrate compaction often hinders the roots ability to displace substrate particles necessary for proper growth and development. This resistance is termed mechanical impedance. The restriction for root growth and development also effects the plants ability to supports itself in containers.

At Purdue University, we evaluated the effects of substrate compaction on vegetative shoot and root growth and development of popular annual bedding plants. In our experiment, we filled 4.5" containers to the rim with loose, free-flowing Fafard 2P mix. Containers were set into shuttle trays with a carrying capacity of 15 pots per tray. We weighed

Figure 3. Compaction of container substrate can occur from "nesting" containers and trays on top of each other.

Cooperating Universities

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a single tray and recorded the weight before stacking and nesting another tray on top. We determined the weight of each subsequent tray nested on top of another until we stacked a total of 9 trays. The bottom tray (layer 1) exhibited the most substrate compaction while the top tray (layer 9) was loose and not compacted. The stack of trays were covered and placed on a greenhouse bench for 3 days until we carefully removed each tray to determined substrate compaction. Substrate compaction was determined by measuring from the substrate surface to the rim of the container. We then transplanted 28 day old 'Wave Purple Classic' petunia plugs (288 plug size) into the containers with various compaction densities. Plants were grown in a glass-glazed greenhouse for 4 weeks under ambient daylight with supplemental light provided by HPS lamps for a 16 h photoperiod and an average greenhouse air temperature of 69 ºF. Plants were irrigated as needed with clear acidified water and acidified water supplemented with fertilizer.

Purdue University Results

In general, substrate compaction increased as the the layer of shuttle trays increased. Shuttle tray

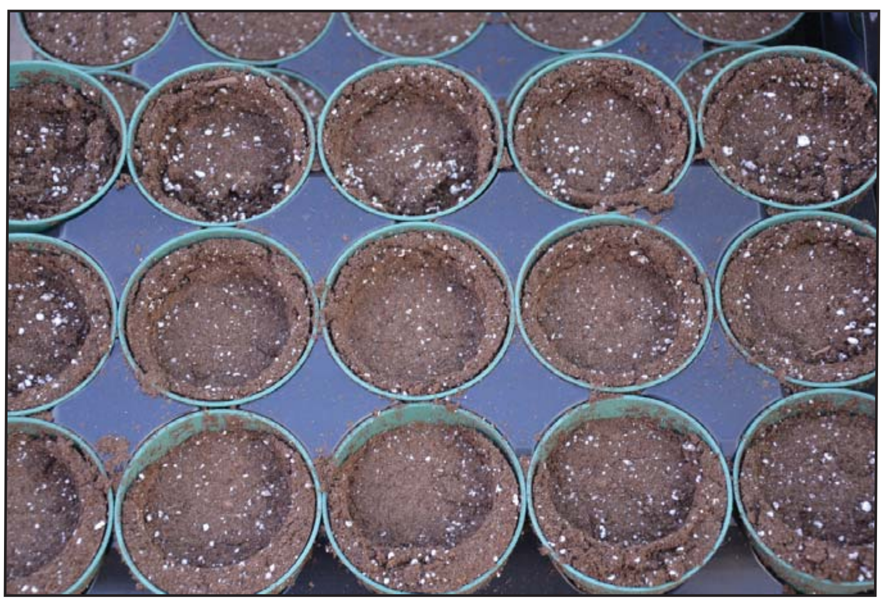

Figure 4. Impression of trays shows how much substrate is compressed from "nesting trays" on top of each other.

weight increased by 8-fold from the second (4.8 lbs) to the bottom layer (38.3 lbs). Root dry weight was negatively affected by substrate compaction caused by the weight of the shuttle trays nesting into each container. Root dry weight declined significantly up to the 5th shuttle tray layer (Figure 5A). The additional 19.2 lbs of weight from shuttle trays 1 to 5 caused enough substrate compactions to negatively affect root growth. Whereas, vegetative growth did not appear to be as negatively affected by substrate compaction compared to root growth (Figure 5B). Visually, plants size increased as substrate compaction increased. Most notably, the top 2 shuttle tray layers (8 and 9) produced the smallest plants (Figure 6).

Trays or containers on the bottom of the pallet or cart can become compacted more than those at the top as demonstrated with our experiment conducted with petunia. Once they are placed on the bench, a grower will notice the vast difference in drainage between the containers that were nested and those that

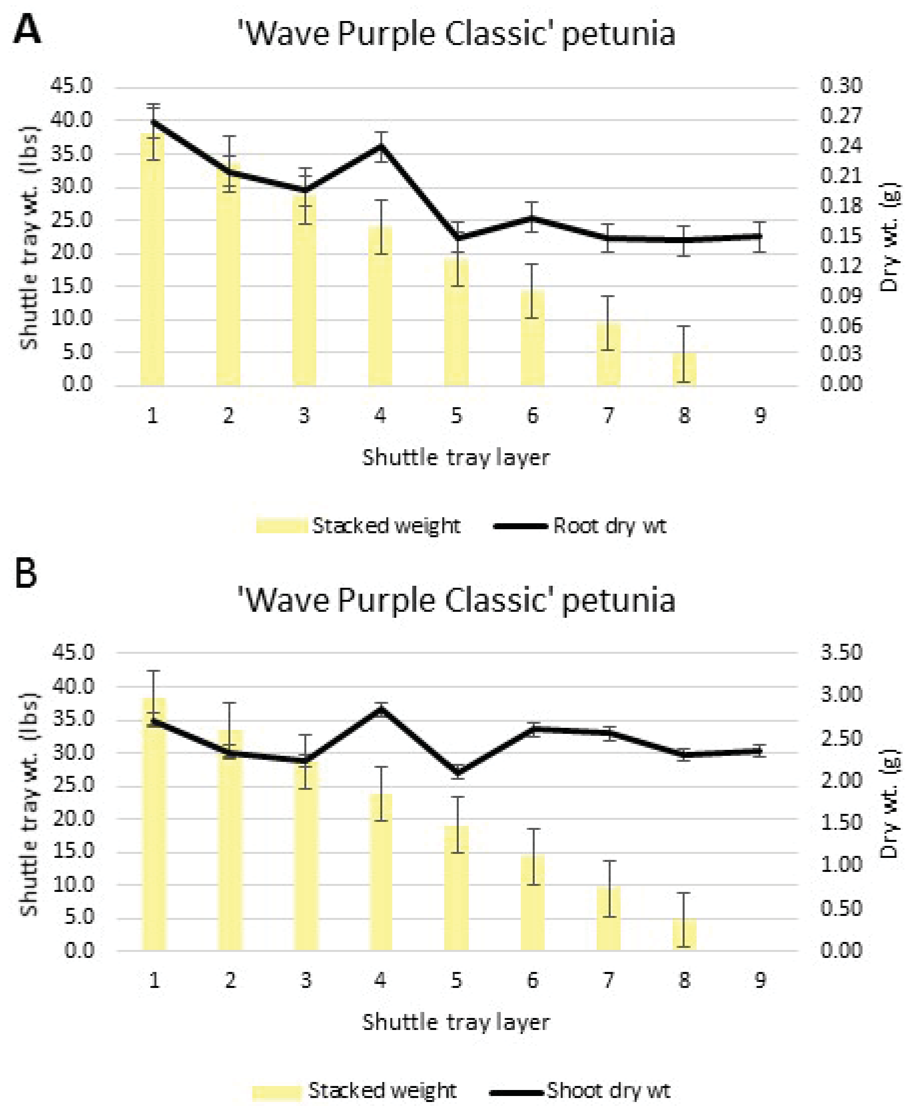

Figure 5. Shuttle tray weight affects root dry weight (A) and vegetative growth (B) of petunia 'Wave Purple Classic'.

were not. Additionally, intentional compaction also increases your production cost as higher bulk density per tray means a higher cost of substrate per container, heavier containers for employees to move, and increased shipping weight.

If you must stack your containers or trays, be sure to offset them (Figure 7) or place a rigid material in between the layers of containers (Figure 8) so they do not nest and compact the growing substrate.

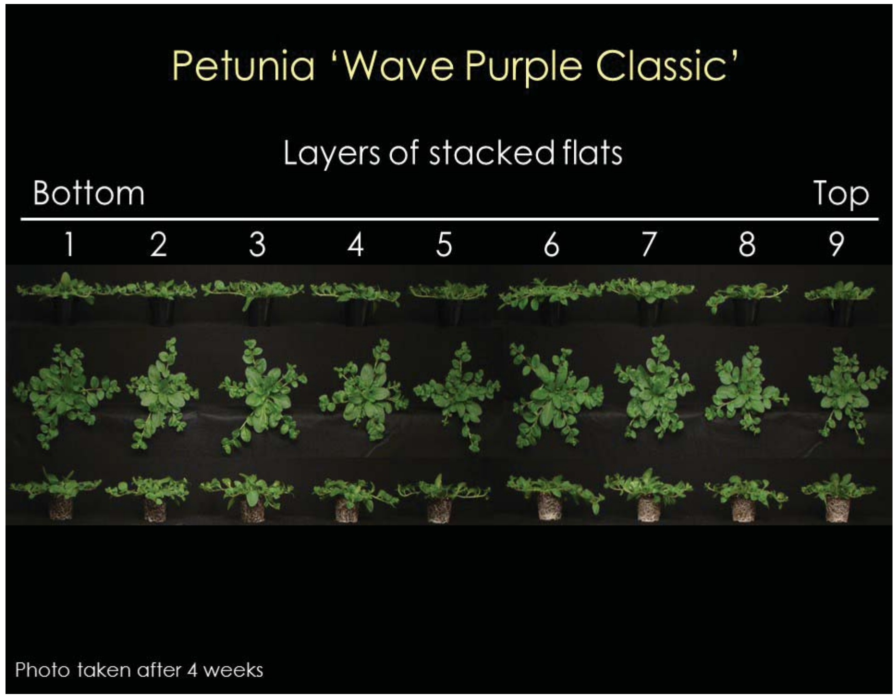

Figure 6. Effect of nesting 9 flats on top of each other on Petunia 'Wave Purple Classic' shoot and root growth.

Figure 7. Offset trays to preventing nesting and substrate compaction (left).

Figure 8. Use flat trays or other rigid material to prevent container nesting and substrate compaction (right).