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Growing with Less: Substrate Stratification can Improve Crop Productivity and Resource Efficiency

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Summary

Soilless substrate stratification offers a sustainable solution to address inefficiencies in greenhouse and nursery crop production. By layering finer media, such as peatlite, over coarser substrates like bark, researchers have demonstrated significant reductions in water and fertilizer use, improving resource efficiency. Stratification helps balance water retention and drainage, mitigating perched water tables in containers. Studies show that root growth doubles or triples in both bark- and peat-based systems when using stratified media. Additionally, this method decreases peat inputs by up to 50%, addressing the current peat crisis. Manipulating stratified layer depths has shown that growers can safely reduce peat use without compromising plant quality. Overall, stratified substrate systems yield higher-quality plants with increased root development while using up to 25% less water and 20% less fertilizer than conventional systems, making it an attractive alternative for sustainable crop production.

INTRODUCTION

Decades-long-worth of soilless substrate research has studied how and why our greenhouse and nursery soilless substrates are either (1) inefficient or (2) unsustainable. In recent years, we have taken this information of what we have learned to develop an eloquent solution to improve these inefficiencies and increase production sustainability.

Soilless substrate stratification is a basic and natural concept, serving as an applied solution for the specialty crop industry. It most often involves layering a finer textured media on top of a coarser textured substrate, such as fine bark over coarse bark, or peatlite over bark. Through several studies, researchers continue to see similar results. That is, we are growing equal or superior crops with less resource inputs. The stratified concept helps control the balance between water and air storage, as well as helping with fertilizer management.

Gravity quickly pulls water downward the second we irrigate a container. As a result, scientists can easily measure that the medium dry in the top of the container. However, the bottom stays wet, which leads to a perched water table at the container base). How a stratified substrate works is by placing finer textured media on top, the smaller pores help hold onto water that is quickly lost to either gravity or evaporation at the top surface. When we place a coarser textured substrate that doesn't store water well and has good drainage, we can alleviate the perched-water-table effects.

The results of our research suggest that we can produce a similar or better crop than using conventional media in nursery containers. Using stratified media led to using up to 25% less water and 20% less fertilizer. In addition, a grower can use a single screen to separate fine and coarse bark particle and still receive the stratified substrate benefits.

Working with some Louisiana growers, we found that stratified systems can help address the current peat crisis. Results from our initial peat-based stratified substrate research showed that we can successfully layer an expensive and high-quality peat-based medium, such as peatlite, on top of a less costly medium, such as bark. Doing so reduces peat inputs by 50%, but still leads to the production of high-quality plants.

Another advantage of substrate stratification in nursery and greenhouse production is the enhancement of plant root growth and development in containerized systems. In one study, we found that in nursery systems (bark-based; fine bark over coarse bark), root growth (based off dry weight) doubled in the top half of the container. In addition, root growth tripled throughout the entire container profile. In a greenhouse system (peat-based; peatlite over bark), an opposite pattern emerged. In the earlier stages of root establishment, we found they accumulated in the top half of the container (that is, in the peatlite layer) for a longer period of time than in conventional media. However, when the roots finished growing in the top half of the container, and began growing into the bottom half, root growth dramatically increased along the entire container profile. Again, root growth doubled, but this time in the bottom bark layer, with root growth tripling throughout the whole container.

When we present our research on stratified substrates, we are often asked, "What happens if you change the stratified depth layer?" We conducted a greenhouse study exploring if manipulating the depth layer changes growth and development and allows us to further reduce the amount of peat applied. We found that growers can safely stratify up to 50% volume per volume with no negative impact on plant growth. However, we observed that layering 25% peatlite atop 75% pine bark negatively impacted plant growth. We are still exploring these relationships in nursery production systems.

The overall benefits of growing plants in a stratified substrate system relative to conventional substrate systems include higher-quality plants that are taller with greater root growth with the use of much less peat (often up to 50%), water, and fertilizer.

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