A Common Misconception About Substrates

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It's a confusing time. Change has always been a part of the greenhouse business, but today, the rate of change is increasing at an alarming pace. The areas of change seem staggering. Pesticides... which one can we still use? Pests... who ever heard of tomato spotted wilt 10 years ago? Import pressures... cut flower production was first, now pot plants? Labor supply... fastest growing segment is migrant Spanish-speaking workers who live near the production facilities. Ground water contamination... change our watering and fertilizing procedures? Capture runoff?

The only thing changing faster than the problems facing growers is the amount of information out there to help solve them. Twenty years ago, growers could count on the fact that once they learned something, that information would be useful for years to come. Today, the longer growers use the same piece of information, the greater the chances of becoming obsolete,

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missing marketing opportunities, or being "*caught*" with serious environmental problems.

The ground water issue has brought into focus the relationships of substrates, watering, and fertility. In order to combat possible chemical contamination of water supplies, substrates are changing. The research for the next generation of mixes is underway. The goal is to reduce water and nutrient runoff from the greenhouse. This will be accomplished by using less of each and capturing the excess. Mixes will be redesigned to hold more water and nutrients. But this creates a new problem. As a director of R&D for a major soil mix producer told me, "Bill, I've spent the last six years making my mixes 'fool-proof'. Now, I'm working on mixes that hold more water and nutrients. But they will be harder to manage." These mixes will be harder to manage because growers will have to learn how to water and fertilize "all over again."

This is no small task. One question I frequently ask growers when I visit them with my greenhouse production class is, "What is the most difficult task to teach a new employee?". The answer is always the same... "to teach them how to water a crop properly." Indeed, one of the factors contributing to the growth of container production was the development of "soilless" mixes in the 60's by Drs. Ray Sheldrake and Jim Boodley of Cornell University. These mixes had higher porosity and could be watered more frequently for container production. As commercial mixes became the norm for greenhouse production, they were even more porous, and therefore, more forgiving. Water and fertilizer were "cheap" and mixes were designed to take lots of them. Now we have to learn new water and fertility strategies for the '90's and beyond.

One of the hurdles that must be overcome in learning how to water is understanding soil-plant-water relationships. All three aspects must be considered when determining when and how much to irrigate. Along with this are misconceptions among growers about substrates themselves. I would like to focus on one of these in hopes of reducing rather than adding to the confusion.

The biggest misconception that I see among growers when it comes to substrates is that the mix is responsible for setting up the air and water relations for the root system of their crop. Actually, substrates account for only about 25% of this responsibility. Seventy five percent of the air and water relations for a plant in a container sitting on a greenhouse bench is controlled by the grower (Figure 1).

Part of the confusion is that many growers think the substrates and their components come with certain physical and chemical properties which are "built in." This causes them to focus on the components themselves instead of the properties they produce. One of the first questions a grower wants answered when confronted with a new mix is, "What's in it?" Many growers also think that these properties do not change. This is a hold over from thinking about field soils. Most field soils have certain properties that are attributed to it. In fact, they are classified according to these attributes. Therefore when a farmer examines a piece of land for potential production, he can be relatively assured that once these properties are known, this soil will behave in a particular manner practically forever.

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This is not true for container substrates. For example, some growers will not purchase a mix unless it has Canadian sphagnum peat moss (CSP) in it. They like the "drainage, water retention and nutrient retention properties" in it. Indeed, CSP is a fine substrate and is common to most mixes used today. But as anyone in the "peat business"

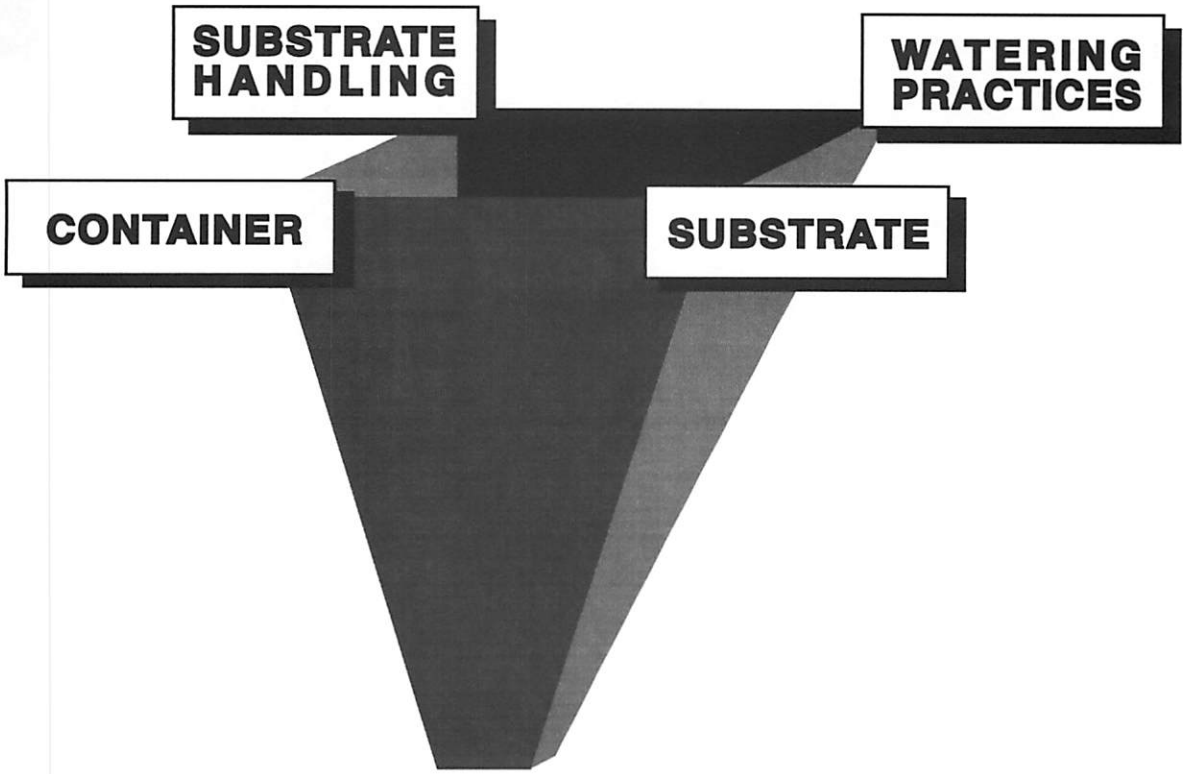

Figure 1. All four of these factors--the container, the substrate, substrate handling practices, and watering practices--contribute to the air and water relations of the plant in a container.

can tell you, there can be tremendous variability in properties of any peat depending on many factors: bog location, age of the bog, depth from which the peat is harvested, the method of harvest, moisture content of peat during harvest, etc. Most companies do their best to control the above factors, so that their product is consistent and uniform. But the resulting properties are because of their efforts, not because of the fact that it is CSP.

Another example is vermiculite. If you ask growers why they use vermiculite, most will say for drainage and cation exchange properties. In 1990, as the supply of #2 grade vermiculite became scarce, many growers switched from #2 to #3 which has much smaller particles. Some simply substituted directly using the same amount of #3 as they did #2. The results were disastrous. Many crops were stunted or killed because of overwatering. The #2 grade vermiculite is coarse and contributes to drainage. The #3 grade material holds much more water. In fact, in bedding plants and plug production, the drainage in a 1 peat: 1 vermiculite (#3) mix comes from the peat - not the vermiculite.

Most mixes today are blends of two or more components. The chemical and physical properties of the resulting mix are not always equal to the sum of its parts. Making mixes is like making soup. When the ingredients are first added, you can pick out all of the flavors of the ingredients you added. But after cooking for awhile, the flavors blend to create new ones. When greenhouse mixes are blended, the chemical and physical properties of the components are "married" to each other to form new properties that are different from the individual components. Oh, you can still pick out the "carrots" and the "celery" in a mix but they now have an expanded role in the "soup."

Interestingly enough, growers care more for what's in the mix than do the plants. Plant growth is a result of the plant's response to environmental conditions, both above and below the soil surface.

Plants do not "care" what the material is in which *they* are grown. Root growth and uptake is influenced by water and air content around the root, as well as nutrient concentrations and salt gradients.

We must shift our thinking from ingredients and components to properties and parameters. By doing this we begin to think about the plant's needs as well as open up a world of material for use in the mixes for the next century.

Another question often asked about a new mix is, "How much aeration does this mix have?" or, "How much water does it hold?" This misconception that fixed quantities of air and water holding capability come in the "bag" extends to some salespeople of mixes themselves. I'll never forget how excited a salesman from a particular company was showing me his "high porosity" mix. He stated that it had 30% aeration (by volume) in the bag. He was adamant that this particular mix would give 30% aeration to a 6-inch poinsettia as well as to a 288 petunia plug.

According to the laws of soil physics, this is physically impossible in mixes used in the greenhouse industry today. If there was 30% in the 6-inch pot there was no more than 2 to 10% in the plug. The amount of air and water held in a mix is determined by at least three other factors: the container in which it is grown, how the substrate is handled (compaction, moisture content, pot filling technique) prior to placing the plant/seed into the container, and the watering practices used by the grower (Figure 1).

The good news is that the air and water environment in container production is directly controlled by the grower - just like fertility. The bad news is that the old adage about greenhouse production is still true..., "The person on the end of the hose controls your profits." Hopefully, by understanding the true nature of substrates and what you can expect from them we can develop irrigation and fertilization strategies best suited for the 90's.