Researcher's Perspective on Current and Future Water Quality **Research**

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There is an expression that says, "Take change by the hand before it takes you by the throat." The change that is occurring in the public arena is one of perception, One of the contributors to this workshop stated that there is a perception in the public's eye that agriculture is the villain; the one contaminating and using too much water. There is also the perception that agriculture is the cause of all nitrates in groundwater.

I think the hand of change is still extended. The hand is very weak, but we can still take change by the hand and cooperatively develop crop production techniques that are safe for the environment. It is especially encouraging to see the recent cooperation among industry leaders, ASHS, and universities. We can do some things in the future to demonstrate that those in the nursery industry are environmentalists. We are trying to prevent global warming and to provide an atmosphere so people can enjoy life on this planet. We are not trying to poison the water systems of the world.

One of the problems with the nursery industry is that in some cases excessive amounts of fertilizers and pesticides are used. In another session, Charles E. Hess, the Assistant Secretary of Agriculturefor Science and Education, alluded to this specific problem with nurseries. I am not sure of the exact quote, but he made it clear that there is a problem with the nursery industry. Basically, the problem is that five to 10 times more fertilizer is used on container nurseries—whether slow-release or liquid fertilizer — than is used on field-grown agronomic crops. And of that applied, only a small percentage is actually used by the plant. The rest is going somewhere. But where does it go? About 4 to 5 years ago, I was visiting nurseries trying to determine the extent of nutrient runoff from container nurseries. I went into one nursery to check the runoff to see if it contained any pesticides or fertilizers. The manager immediately said that he did not have any runoff problems, so I could go right ahead. While I was there, I took a water sample from a drain leaving the nursery and found elevated nitrate levels in the water.

From a research perspective, I really did not know the extent of the problem for container nurseries, so a regional study was initiated involving Virginia, North Carolina, Florida, and New Jersey to monitor runoff of nutrients from container nurseries. Alabama, Ohio, and Washington later became part of the study. Grants from the Horticultural Research Institute and Grace-Sierra helped fund the study. Basically, we found that there is often a problem for container nurseries in relation to nutrient runoff, but there are some nurseries that grow excellent plants by properly using slow-release and liquid fertilizers, singularly or in combination, without having unacceptable levels of nutrients in the runoff. With current technology, nutrient runoff problems can be prevented. Yes, it will be at greater expense to the nursery operator, but runoff can be prevented. There are examples of nurseries that have overcome runoff problems by either retaining all runoff water and recycling it, or using the best management irrigation and fertilizer practices so that runoff water meets U.S. Environmental Protection Agency standards. If researchers, educators, nursery operators, and industry organizations work together, we can overcome the runoff problems and demonstrate to the public that we are good managers of the environment.

As far as specifically identifying critical areas in which to concentrate research, I would like to emphasize the importance of relating nutrient and pesticide runoff to irrigation management. Nutrient runoff and irrigation scheduling cannot be separated. There are many examples in the journals of nutrient management studies where no consideration was given to irrigation frequency and amount. When evaluating plant growth as the end product in our research programs, we must consider the interaction between fertilization and irrigation. The changing nutrient and water demands of a plant during the growing season must also be taken into consideration. With the technology available to determine plant and soil water status, it is possible to schedule irrigation based on plant need. We need to consider the plants nutrient needs on a weekly or monthly basis as the plant develops. We must develop some understanding of plant nutrient needs as they change during the growing season.

In recent years, we have been perplexed over how to supply nutrients in relation to plant need. If we read the literaturecarefully, we may find insight into our questions without conducting extensive research, and we will not have to reinvent the wheel. For example, one way nurseries have reduced water and fertilizer use is to apply small amounts of water and nutrients in multiple applications during the day. This would be in contrast to applying all the water and nutrients in one application. This approach is supported by basic plant science research that demonstrates that a plant will absorb just as much N if the root is exposed to low concentrations of nutrientsand the low concentration is constantly maintained. The plant will take up as much nutrients and grow just as fast as the plant growing under high-nutrient conditions. The driving force for nutrient uptake is plant need. If nutrients are maintained at that root interface, even though the concentration may be low, comparable nutrient uptake will occur. Obviously, the approach of applying small amounts of water and nutrients frequently reduces the potential for nutrient leaching and runoff from nurseries.

Controlled-release fertilizers certainly have a place in managing nutrition of container-grown plants. We need to understand more about how these fertilizers work, and how the nutrient release characteristics relate to plant nutrient uptake. We need to be working with manufacturers to develop controlled-release fertilizers that release nutrients in relation to plant need. Currently, many of these products release too much fertilizer in the early part of the season, when plants need less, and too little in the latter part of the season, when plants require more.

For a long time, I have been a proponent of fertilizing to get the maximum plant growth rate possible since nursery plants are sold according to plant size. Considering the law of diminishing returns, growth decreases with each increasing addition of a nutrient after reaching a growth threshold. For example, it may take only 100 units of N to reach 90% of maximum growth, but it may require another 100 units of N to reach 100% of maximum growth. The 200 units of N vs. the 100 units may be the way to go since a larger plant would probably result in 50 to 75 cents more per plant. However, if that nursery operator is faced with paying $1000 a day in fines because of excessive nitrates in the runoff water, the nursery operator may settle for 90% of maximum growth and have clean water leaving the nursery.

Also, we do not want to get away from the pesticide issue. The mentality in the retail trade is if a plant has leaf damage due to an insect or disease, then it is not marketable. Maybe we will have to accept some plants with insect damage in the garden center. During the 1990 ASHS Annual Meeting, I became even more convinced of this. In the colloquium, "The Impact of Reduced Pesticide Tolerance Legislation," we learned that when dealing with the production of cabbage for making sauerkraut in New York, standards are set on the number of thrips that would beallowable in the sauerkraut. Now, if processors can tolerate a few thrips in their sauerkraut, why can't we, in the interest of reduced pesticide usage and clean water, have a few insects or some insect damage on our nursery plants that go into the landscape?

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