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Resolution Awaits for Biostimulant Use in Water Sanitation

The chemical-biological conflict in water sanitation requires researchers to pivot their focus to find a solution that brings the best of both worlds.

By Peter Konjoian

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As a private sector researcher, I face many of the same challenges as my academic colleagues. One challenge is learning how to pivot to new areas once a research project ends. My colleagues no doubt agree that while a familiar research focus is comfortable, choosing new challenges broadens one's perspective. Like a grower learning to grow new crops, opportunities to tackle new research ideas are rewarding, and a broad understanding of a complex issue is usually helpful. Working on irrigation systems and water treatment has been helpful in embracing the challenge ahead regarding the incorporation of biostimulants into production practices. It's here that the conflict and reconciliation of this article lie.

One Direction Is Easy, Recirculation Is Harder

The objective of irrigation system sanitation and water treatment is to kill microorganisms. Specifically, the objective is to kill algae, manage plant pathogens such as *Pythium*, and control biofilm whose common description is a self-supporting community of naturally occurring, highly evolved bacteria. What do these three targets have in common? They're all microbes if we loosely accept that the types of algae involved in irrigation systems are microbes and different than higher forms, such as giant kelp.

Intensifying the conflict is the expanding use of recirculating irrigation systems. Pushed to even greater limits is hydroponic production, where the root zone is mostly void of physical growing media components. To date, my research and that of others has focused on developing protocols for various products and product categories (oxidizers, membrane disruptors, etc.) to treat irrigation systems and the water delivered to crops. Our focus is to essentially kill everything and deliver sanitized water to the crop in a field, greenhouse, or vertical farm.

Traditional, one-directional irrigation systems are the easiest to deal with. Treat the lines and water flowing through them at concentrations safe to apply to the growing medium surface. But once we decide to recirculate and use the water repeatedly, watch out. Again, this is less of a problem with crops grown in traditional growing mixes compared to hydroponics.

The way I describe this is to think of the organic components of traditional mixes — the peat, bark, and coco coir as buffering agents. In this role, they neutralize oxidizing compounds and otherwise tie up other categories of sanitizing chemistries. The result is a convenient way to treat irrigation lines, deliver treated, sanitized water to the crop, and avoid causing phytotoxicity to the root system because the growing medium neutralizes the chemical by acting as a buffering agent, a protector. However, any of the products used this way can be overdosed and cause phytotoxicity.

Once we capture and recirculate the solution, be careful. We need to understand what level of residual activity of the sanitizer is returning to the reservoir before we can add make up solution with more sanitizer and send the solution back out for another irrigation cycle.

On one hand, the concept of recirculation and its 80% to 90%

This figure shows the results of lettuce grown in nutrient film channels. The left image is the untreated control, the center had a membrane disruptor applied to the irrigation system, and the right had an oxidizer applied to the irrigation system. Photo: Peter Konjoian

reduction in water consumption is without doubt our future. However, we also need to acknowledge that we're creating a worst of both worlds scenario. First, the recirculation challenge of residual chemistry needs to be mastered. Second, the naked and exposed root system's sensitivity to the chemical needs to be managed. This is solvable, it's not a doom-and-gloom scenario.

To Kill Or Not To Kill

To what degree of efficacy we try to sanitize an irrigation system and the water flowing through it may depend on which irrigation strategy is in use. One directional, drain to waste is easy.

The tougher nut to crack is treating recirculating hydroponic systems. There are two levels of concern for these systems. First, before even considering biostimulant inputs, a compromise must be found between how much chemical exposure is supplied to kill the undesirable microbes vs how much exposure the naked root system can tolerate before experiencing phytotoxicity. This research is currently underway. An article summarizing my progress to date will appear in an upcoming issue of *Greenhouse Grower*.

Second, once we learn enough about the benefits of using biostimulant products in recirculating hydroponic systems, the next conflict takes center stage. To kill or not to kill. Are we going to be faced with tolerating algae, plant pathogens, and biofilm in order to leverage the benefit of the biostimulant? Or are we going to kill the biostimulant because we need to control the algae, plant pathogens, and biofilm?

Will we be lucky and find a sweet spot like we did with steam pasteurizing soil-based growing mixes? How fortunate we were that a steam treatment of 180°F for 30 minutes killed plant pathogens and weed seeds while not destroying beneficial nitrifying bacteria.

Will we be as fortunate to learn that various sanitizing agents used at lower than currently recommended concentrations will not be phytotoxic to hydroponically grown crops yet effective in killing unwanted microbes? This is being researched as these words are typed. But biostimulants toss a monkey wrench into these systems. Is this another example of 'east meets west' where a merger of approaches is in order? Today's message is that the solution is not likely to be "to kill or not to kill" but, rather, "how much to kill and how much not to".

Reconciliation

One solution may be to use the sanitizing agent less than continuously, periodically pulsed, in order to use the biostimulant during the gap periods. Recent experiments have produced encouraging results using this tactic for the sanitizing side of the conflict. Will these concentrations allow biostimulants to perform satisfactorily or inhibit their activity? It's exciting to study this question.

To conclude, we need to start talking about how we can reconcile the chemical-biological conflict knocking on the door. Blurring the lines between the two philosophies and navigating an "east meets west" challenge awaits. **GG**