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Tech Talk: Bane or Boon? A Brief Look at Horticultural Tech

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Summary

Current technology allows us to grow quality plants, while reducing many of the input costs - like time and labor. In choosing new technology, be selective. It is not necessary to adopt every new gadget, app, or service that comes down the pipeline. Much research and development are out there waiting to help us with this. R&D, Use the information out there. But you should be aware of many growing factors, and utilize tools to tweak things one way or another.

INTRODUCTION

Prides is a wholesale nursery in Eastern Connecticut with about 500 acres under production across four locations.

I have always loved and enjoyed plants, whether that was my 300 houseplants while growing up, or at my first job-riding my bike after school to work a couple hours at a local greenhouse, doing some landscape maintenance over the years, or floral design along with my wife Lisa in her wedding flower business. Currently I manage our crew in Harvesting field cuttings, and along with my colleagues, direct the sticking, rooting, and grow-on of our internal liner production. We grow fruits, vegetables, trees, perennials and shrubs. With

millions of liners to produce we have to learn, we have to grow, and we need to produce results. This talk is designed to raise questions, pose a few answers and inspire research and investigation.

There have been many changes in the past century of horticulture. All of these changes came with challenges, seen or unforeseen, that push us to grow, to learn and to understand more aspects of what makes a healthy plant. A happy plant. In many respects as horticulturists moved further from nature we have had to get better at nurture. Spoiler alert: There is more to growing than sunlight and H_2O.

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Some changes in industry practices, which are designed to maximize space, reduce residency time and streamline transport to customers, have affected many growing factors. Container and tray sizes impact many soil aspects, including changes in volume, weight, composition, moisture, temperature and root-to-shoot ratio.

Every advance leads to new challenges. A simple advance — moving from ground to pot or container - yields the question: What do you put in the pot? Dirt? Soil? Media? Where is the technology? It is in things we can measure such as weight, porosity, pH, EC, soil nutrients. These are all things we can measure. But what is our target? Education and Research can help us find an Optimum range. Simply the ability to take samples and test pH or EC on our own without sending out to a lab increases our ability to react and make adjustments in our grow program. This is especially important if lead times continue to shrink, tightening of sales windows or changing customer needs.

Much research and development are out there waiting to help us with this. R&D, Use the information out there. In today's world going it alone does not make much progress. Much like mathematics we need to build and grow on prior work and knowledge. Why mention this you ask? I want to emphasize the reasons we are gathered in person and online; why we belong to IPPS; To seek and to share. A person could pick one genus or even one species and study it for a lifetime. One could also spend a lifetime reading innumerable books and internet articles (preferably those ending in --- edu which are more reliable sources of information than simply “Bob's Garden blog”). Another tool that has become more available in the past year is collaborating with colleagues over video conferences.

But where is the tech with a capital “T”? It is in the data. Technology available today can gather infinite data points. We have moved beyond daily high/low temperature records. Sensors can collect information all day and all night. Pair them with software and that data can be collated and graphed. It can be turned from numbers into pictures. And as we all know “a picture is worth a thousand words”. I for one have found a graph to be nothing more than a pictorial representation of data. Easier to see, easier to understand the current conditions, where they are going, and most important where they have been. We cannot collect data for data's sake alone. Data is only useful if accurate and one is able to understand the correlation to the factors we are trying to measure or control. Technology sitting on a shelf, or a dusty corner is never effective. Whether that technology is simply a handheld pH or EC meter, high-tech control system, pruning machine, mulching machine, or fertigation injector.

You've heard that those who don't learn from history are doomed to repeat it. When plants yield results, whether good or bad, without reliable information; you are not doomed to repeat those results. You cannot know what factors went right or wrong and therefore repeat outcomes or avoid pitfalls. This is where collecting data pays dividends. A grower quote "Don't fly blind, use your diagnosis and records as a tool for now and into the future." I will grant that an experienced grower can continue to grow year after year relying on personal knowledge. But that breadth of knowledge has become harder to source and hire, as companies get bigger, competition changes the playing field, and new talent (as in many industries) finds specialization more prevalent.

Mist timers and clocks are simple and effective tools to maintain a desirable rooting environment in propagation. Current models allow for programmable changes to mist frequency during the day. A simple example of a misting day could be to have three programs. 'Program A' running from 8 AM to 11 AM at 30-minute intervals; "Program B' running 11 AM - 3 PM every 20 minutes increasing the mist frequency during the heat of the day, and 'Program C' from 3 PM to 8 PM misting every 25 minutes. The ability to program this in advance can eliminate some of the labor involved in making manual changes throughout the day. But time alone is not the only factor. When the weather changes or crops age, growers benefit from making manual adjustments to maintain the growing environment. The newer mist clocks available on the market have added functionality, such as light sensors (to reduce mist during cloudy periods) which can make some automatic adjustments.

Irrigation valves can be automated with timers, but share similar limitations. Electronic and wireless options are now on the market. These provide more flexibility for remote access to modify your watering schedules. When conditions change, remote accessibility allows a grower to make necessary adjustments without having to be on the site of every irrigation valve. Manually changing valves uses a lot of labor, which can be significantly reduced by electronic valves. There are even some wireless valves available with bluetooth capability. Wireless models will reduce the complexity and cost of installation as well as maintenance on the system, as wired units are subject to damage from rodents and equipment. In my personal experience, I have experienced a change from manual ball valves to wired irrigation clocks. This saved more than an hour a day in manually changing more than a dozen valves. A grower will still need to oversee systems to make sure the equipment runs properly. More than once when cycles failed to run, I found evidence of cleanly cut wires which appeared as sabotage, but upon closer inspection, the culprit was identified by the pile of droppings Peter rabbit left behind. The takeaway is: utilize the technology available, but be conscious of its limitations and ensure there are failsafes in place to protect your crops.

Another example is advancing from individual thermostats to control heating, ventilation and airflow to dual or multiple stage thermostats which enable these environmental factors to be managed without competing against each other. When these are on individual thermostats, overlap can occur causing heating and cooling mechanicals to operate simultaneously causing a bad situation. A common greenhouse heater is an oil-fired furnace, which can backdraft and cause a fire if the ventilation system reverses the exhaust airflow, or burn-out heating equipment, requiring expensive repairs (sometimes at 3 AM. in sub-freezing temperatures). In a less extreme scenario, it can simply burn fuel excessively, hurting the

bottom line, especially if it goes undetected. Additionally, depending on the crops, exhaust gases from continuously running equipment can adversely affect plant health. These situations can occur due to placement of the individual thermostats, aging equipment, or human error. The newer multistage thermostats provide lockout control maintaining separation of heating, cooling, and ventilation functions. With a single multistage unit, placement and wiring are simplified. The possibility of multiple units being accidentally adjusted is also eliminated, reducing the human error factor. Oversight is still required to manage set-points and make adjustments for different growing conditions and the weather at your location.

Another important tool at your disposal is the sensor equipment to help trigger or monitor these various systems. Sensors are available to monitor the temperature of soil and air (in the greenhouse and ambient). Soil sensors can measure pH, EC and moisture. Other sensors for those critically important light levels can measure PAR and DLI (daylight integral). You can monitor humidity in the greenhouse, vapor pressure deficit (VPD) and other factors in your facility. Without sensor data, you might be growing by the seat of your pants, which may work for some growers with many years of trial and error under their belts. Before sensors were available to quantify these various growing factors, human input was required to make decisions and adjustments on an ongoing basis. Labor and time were required to take soil samples and ship them to the lab for pH and EC analysis. Temperature and humidity were read manually in each growhouse, which would then require adjustment. Every adjustment required the judgement of a knowledgeable grower, who needed to be onsite to make those adjustments, often multiple times a day, within each growing area. This becomes completely untenable in a larger operation. When growing conditions are not monitored and adjusted in a timely fashion, crops are subject to additional stress, leading to plant health issues or, ultimately, crop losses. When data is easily accessible, growers can make more informed, proactive adjustments, instead running around like headless chickens, doing damage control.

Although wired sensors are available, it's not practical to have multiple wired systems in each grow area monitoring all the necessary data. Wired sensors can also be prone to damage by pruning equipment, which I have witnessed. There are now wireless sensors on the market, which are simple to install and use, without the hassle of running wires to half a dozen sensors. I have installed dozens of them myself; each in a minute or so. The Bluetooth capabilities of many of these sensors allow growers to monitor conditions, receive alerts and even set alarmed parameters, while walking through the grow area. By using a WiFi gateway, the visibility of these sensors can extend to the internet, and be available on any device with internet access. To the grower at home, or the on-call nursery crew, this means fluctuations can be identified immediately, minimizing potential crop damage. Case in point, I received an alert one night when one of our greenhouses fell below temperature. I was able to pull up the sensor data that indicated a heater failure. Our on-call crew was dispatched, and the issue resolved before any crop damage could occur. Having sensors to monitor and track data on an ongoing basis is much more cost effective and reliable than periodic, labor-intensive manual data-collection. Moreover, a single adverse event that is

prevented by sensor data will easily offset the upfront equipment costs.

Taking the next step up with a control system. These can group even more factors. A control system can manage environmental factors within a growhouse, react to external weather, and help with irrigation, fertigation, and misting. Tying everything together in sync like never before. This of course comes with new challenges and requires adjustments in thinking as we balance the various growing environment targets using prior knowledge and adding new sensors for a greater understanding of the intricacies that affect various crops. Never fear! You can still fly by the seat of your pants, but do so while gathering multiple data points to quantify and graph your environment. Sometimes mother nature gives us perfect conditions for rooting or growing, but more often not. The more tools we have to supplement what nature supplies, the more consistent our results can be.

The good news: don't be overwhelmed; you don't have to know it all — I certainly don't. But you should be aware of many growing factors, and utilize tools to tweak things one way or another. New technology is not a necessity, but it can help us build on all the knowledge base we have at our disposal. Change cannot be forced; it simply arrives sooner or later. Our decisions determine whether we're in the wave, at the forefront, riding the coat-tails, or left paddling in the wake. Run your CBAs and ROIs (cost benefit analysis and return on investment) but do so while painting the whole picture. It's cheap and easy to get a few sensors or test probes. The power to drive great change might fit in the palm of your hand.