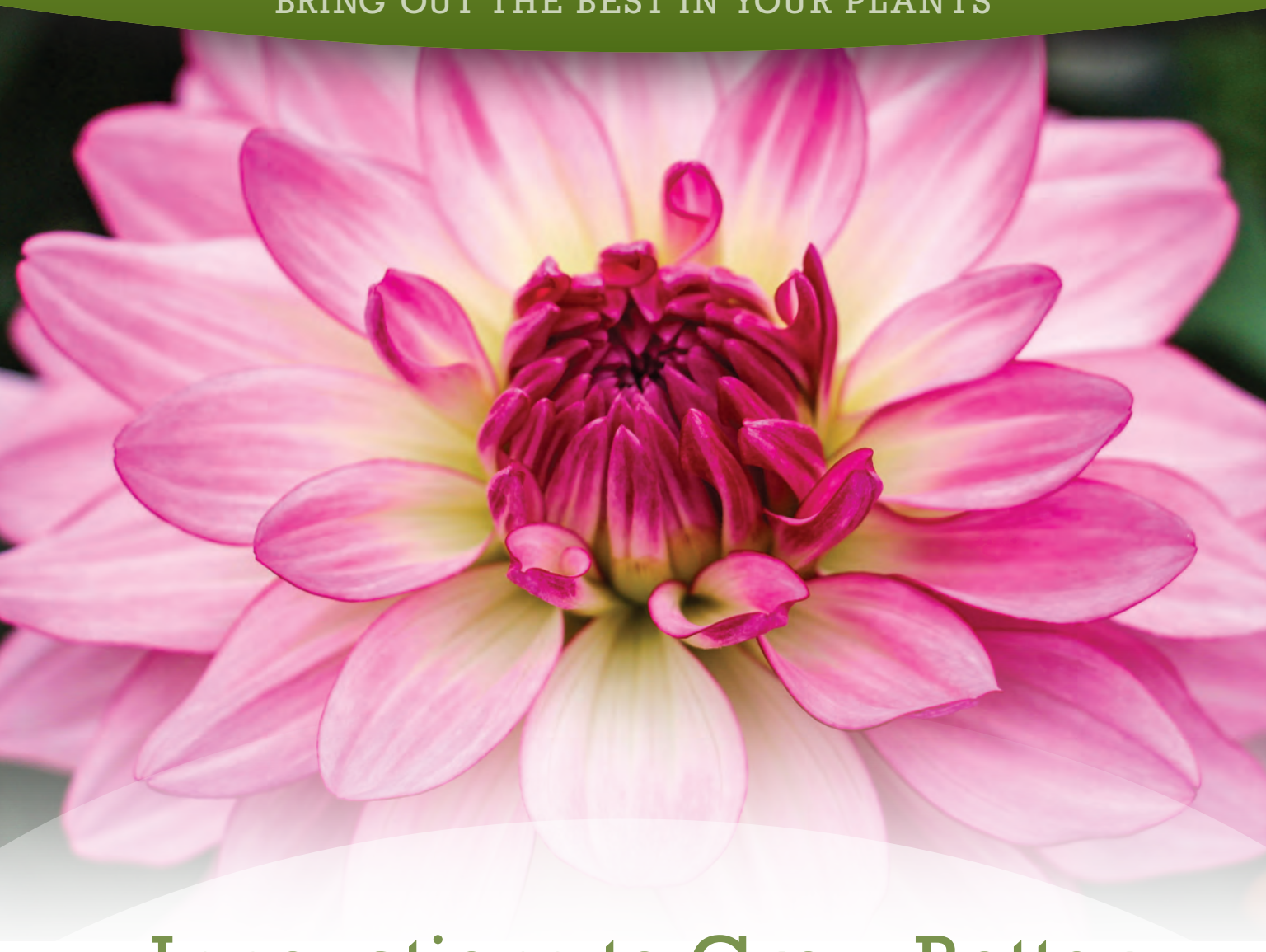
Plant Health

BRING OUT THE BEST IN YOUR PLANTS



Innovations to Grow Better Plants and Save Labor

- Cutting-edge technology that uses artificial intelligence to identify problems quickly
- Biocontrols and biostimulants: the 24/7 workforce

BASF
We create chemistry

Riding a Wave of Change

By Joe Lara

This edition of the Plant Health Series focuses on how industry innovators are assessing the dynamic changes occurring in our industry and finding ways to harness emerging technologies that meet the ever-increasing challenges and complexities of commercial greenhouse and nursery production.

The current issue also reflects the 10-year anniversary of the introduction of the Intrinsic® brand fungicides by BASF. A brief timeline of key industry changes is presented and parallels how BASF has delivered a foundation of crop protection and plant health benefits to horticulture professionals, from commercial greenhouse and nursery growers to turfgrass professionals. The legacy of research, development, and collaboration among top industry leaders has resulted in a history of success for many growers using the range of Intrinsic brand fungicides by BASF.

Joe Lara, Senior Product Manager at BASF

The petunias on the right were treated with Pageant Intrinsic before a dry-down event, and came through with little damage compared to the untreated plants on the left

Initially introduced as one of the broadest-spectrum ornamental plant fungicides, its claim of plant health benefits supported by scientific data was the first of its kind accepted for inclusion on an approved EPA product label. Backed by commercial evidence were the claims of not only exceptional disease control, but also the display of various plant health benefits helping growers achieve consistently high levels of plant quality.

Over the past decade, success stories from independent researchers, field consultants, and top commercial greenhouse and nursery growing professionals touted the business benefits of accelerated rooting and root density, drought tolerance, and recovery from cold and heat extremes, including extended periods of property flooding — to name a few.

Today, Pageant® Intrinsic®, Empress® Intrinsic® and Orkestra® Intrinsic® brand fungicides enjoy wide recognition as a foundation of disease resistance management programs, helping commercial growers protect and ultimately deliver high-quality plants to the most discerning retail customers.

"Over the past decade, success stories from independent researchers, field consultants, and top commercial greenhouse and nursery growing professionals touted the business benefits of accelerated rooting and root density, drought tolerance, and recovery from cold and heat extremes, including extended periods of property flooding — to name a few."

Please take time now to enjoy a special series of articles that shed light on how advancements in technology are influencing today's growing practices and preparing the industry to ride the wave of change.

Joe Lara is a Senior Product Manager at BASF. Learn more about other BASF Professional Turf and Ornamental Innovations at **www.betterplants.basf.us.**

What's Driving Greenhouse Innovation?

Labor-saving technology and smart systems are giving greenhouse growers a modern-day toolbox to improve their operations.

by Kristen Hampshire

Technology such as this potting machine at Green Circle Growers in Oberlin, OH, not only saves time, but also reduces rote labor that makes jobs less attractive to workers.

Labor is a pain—and the pool of potential agricultural workers is thinning faster than many growers can find ways to fill the gaps. "Demographic and societal changes have unfolded over the last 100 years or more, and those have built up over time," says Craig Regelbrugge, Senior Vice President of Industry Advocacy and Research for AmericanHort.

A complex and costly H-2A program is a last resort for growers, but it's challenging to navigate the process and its expense. Plus, longtime agricultural workers are aging out — they're finding other means of employment that suits their lifestyle, either here or in their home countries. This aging out is compounded by a lack of young blood entering the industry, Regelbrugge adds. And, in many instances this work is seasonal.

"Most Americans who are motivated to show up at a workplace and work hard aren't looking for intermittent employment," Regelbrugge points out. "They're looking for full time, and for the most part, they have a lot of choices."

Not to mention, the economic landscape in countries that have historically provided workers is improving. So, foreign workers won't necessarily have to immigrate in order to find employment.

"Regions that have traditionally been big labor suppliers are changing rapidly," Regelbrugge says. "Also, birth rates are falling where they are only slightly above what we see in the U.S. and northern European countries, so the combination of push-and-pull factors that cause people to be willing to walk away from home and strike out to work in a different land are changing."

> "If we move in a serious way toward more mechanization, automation and labor-saving innovations, we are going to need smart people who want to work in horticulture to run the machines."

Beyond the difficulties of attracting labor, the floriculture industry's profit margins are shadowed by those of the growing cannabis industry, which can pay more. And, there's an overall margin squeeze growers are feeling as the cost of business elevates.

What's the answer? There isn't one.

"The best solution is an all-tools-in-a-toolkit approach," Regelbrugge says. That toolkit includes standardizing processes so operations can embrace mechanization. Also, growers need to adopt technology that reduces rote tasks so they can focus on creating more engaging work experiences that will attract labor. If we move in a serious way toward more mechanization, automation, and labor-saving innovations, we are going to need smart people who want to work in horticulture to run the machines," Regelbrugge points out.

Standardizing Processes

It's harder to mechanize a process that isn't standardized. Technology will prompt growers to dig into operations and create uniform systems that can be automated.

"Prices are rising, and producers are struggling to get enough for their product," Regelbrugge says. "We have a big margin squeeze, and in the face of that, the place to start is to push for 'lean flow.'"

In other words, growers will have to identify how product flows through their operations, address barriers to flow, and pinpoint processes that can be improved with technology.

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Plant Health
Bring Out the Best in Your Plants

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Adopting Technology

"The pressure of consolidation and logistics is driving growers to improve processes, and that includes technology," Regelbrugge says. "For example, sensors for a variety of functions—plant nutrition, pest and disease management, inventory — can alleviate the labor burden. It can mean fewer bodies are necessary to do 'the rounds.'"

In a 2018 *Greenhouse Grower* Top 100 Grower survey, 83% of respondents said they are investing in technology and automation wherever they can to counter labor shortages. Of those, 72% are focused on boosting efficiency, and 58% are adopting technology to improve production uniformity and efficacy.

Technology investments include: production automation (59%); software (47%); building and replacing structures (42%); watering efficiency (41%); and LED lighting and growing media equipment (34%).

"Greenhouse is ahead of outdoor production nursery because it's easier to embrace technology in a controlled environment," Regelbrugge says. "But, I think that gap will close pretty rapidly."

Reimagining Hort Careers

"Labor challenges are up and down in our companies and include growers, propagators, pest control managers—it's not just entry-level, manual-labor jobs growers are struggling to fill," Regelbrugge says.

Technology is a key piece of changing perceptions of working in this industry. Mechanizing some manual processes can allow growers to "upgrade" positions, Regelbrugge says, so they are more varied, more interesting, less rote and manual.

"It's not about replacing workers; it's often about making a job more attractive," he adds. "As an industry, we need to collectively figure out how to better position and market career opportunities."

Innovative Chemistries Enable Efficiencies

Ten years ago, BASF introduced it's ground-breaking Intrinsic® brand fungicides — the first crop protection product to be allowed by EPA to put "plant health" on the label. The active ingredient, pyraclostrobin, provides excellent broad-spectrum disease control. It also was proven by repeated trials to increase plant growth efficiency and tolerance to stressors such as cold or shipping.

Pyraclostrobin kills fungi by inhibiting respiration, the "dark reaction" of photosynthesis, which breaks down carbon into energy that can be used by the plant.

In plants, inhibiting respiration has a positive effect, triggering a cascade of chemical reactions that result in conservation of carbon in the roots and an increase in nitrate activity. The increase in nitrate results in more nitrogen for plant growth, inhibits production of ethylene (a plant hormone produced in response to stress) and triggers plants' natural defense mechanisms against bacterial, fungal and viral diseases.

What does this mean for the grower? Healthier plants that can rebound faster after an unanticipated dry down or cold spell, increased tolerance to shipping and longer shelf life at retail, and of course, superior control of fungal diseases.

Evolution of Innovation

Innovative products are being created in all areas of horticulture: Growing media, lighting, new varieties, labor-saving devices, and in crop protection. This year, BASF celebrates 10 years of its innovative Intrinsic brand fungicides, used in commercial greenhouse-nursery production and turfgrass management. Take a look back at where they fit in the timeline of other major events in crop protection and plant health in the greenhouse and nursery industry.

2009 Only 24% of growers say they have been affected by labor shortages.
2009 Greenhouse Grower Top 100 Survey

2013 Downy mildew of impatiens quickly becomes a major concern as it spreads to 33 states.

2009 Insignia SC Intrinsic Brand Fungicide

2010 Pageant Intrinsic Brand Fungicide

2011 Honor Intrinsic Brand Fungicide; Pillar G Intrinsic Brand Fungicide

2012 Empress Intrinsic Brand Fungicide

2013

Plant Health Bring Out the Best in Your Plants

Innovation — The Ultimate Labor Saver

by Kristen Hampshire

The robot shown here is a concept, but labor-saving devices like these will likely be part of the future of the greenhouse industry.

A push to improve efficiency is prompting growers to explore innovative technologies that streamline processes, alleviate tedious tasks, and provide more control over crop quality and yield. From basic conveyer belts to robotic transplanters and advanced light systems, there are a range of labor-saving tools on the market today. But, how does a grower decide which technologies to implement?

"As you are going through peak production, observe what parts in your system are hampering production," advises Heidi Lindberg, Michigan State University Extension Greenhouse and Nursery Educator. "If you are spending a lot of time moving plants from one area of the greenhouse to another, consider making changes in how you transport them. And, as you make infrastructural improvements to your facility, work to improve the flow."

Here are some labor-smart strategies growers are putting into play to tighten up operations, alleviate the labor burden and grow profitability.

Smart Technology Moves

Some growers are investing in cutting sticking machines, such as the Visser AutoStix system that can reduce the number of

continued on next page

The Visser AutoStix machine removes the challenge of finding and training employees to stick the cuttings at the rooting stations.

2015 More than half of large growers (52%) say they have stopped using neonicotinoids due to customer/consumer concerns about pollinator health.

2014 Greenhouse Grower Top 100 Survey

2018 Biocontrols are mainstream in the ornamentals industry, with 60% of growers reporting they use at least one form in their operations.

2018 Greenhouse Grower State of the Industry Survey

2018 Labor becomes top concern identified by large growers, with 77% saying they have been affected by labor shortages — 53% more than just ten years ago.

2018 Greenhouse Grower Top 100 Survey

2019 NewGen boxwood, with increased tolerance to boxwood blight, is introduced by Saunders Bros., and plant breeders put increased focus on disease-resistant varieties in many categories.

2014 Lexicon Intrinsic Brand Fungicide

2015

2016 Orkestra Intrinsic Brand Fungicide

2017 Pageant TR Intrinsic Brand Fungicide

2018

2019 Navicon Intrinsic brand fungicide

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Dummen's Basewell rooting technology simplifies the sticking process and is easily used in automated machines.

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employees required on the sticking line. Others are reducing the number of types, styles, and sizes of containers they offer. They're opting to transplant into final, decorative containers.

Meanwhile, advanced lighting systems are giving growers greater control over crops — and the flexibility to grow anywhere, any time. Case in point: helioCORE is a platform that allows growers to control light. They can organize lighting by crop type or production stage, group together multiple lights into zones to standardize schedules and settings and build "libraries" of saved settings. The LED grow lights can be customized to help shape the crop cycle. For example, by inducing red-color light at the end of a growing cycle for red lettuce, you can increase production.

Metrolina Greenhouses installed an Echo-Veyor system 2 from Cherry Creek Systems in their shipping area. The system has significantly reduced the amount of labor needed to process and ship orders.

"We can optimize the cycle time and yield," says Peter Nyberg, Chief Technology Officer at Heliospectra. "Because of our knowledge of light and how to use it in the most effective way, we can use light to control and reduce growers' costs."

Controlling light helps establish consistent growth cycles and yields. "You can predict what crops you will get, and you will get the exact same results every time," says Hanna Rudel, Vice President of Technical Services at Heliospectra.

Light control systems also address America's fluctuating weather patterns. "There have been significant changes in seasonal weather and light levels during the course of the year," Rudel says. "By turning to LED technology and these types of control platforms, you get consistent produce year-round."

Not to mention, light platforms give growers the flexibility to grow anywhere. "You don't have to grow where there's natural light — you can grow indoors, in warehouses, outdoors in the ground, anywhere you want to have your crops," Rudel says. "So, in areas with dense populations, you don't need to make food travel because you can grow it in food factories in the city."

Growers can gain quick time to market, from the moment crops are harvested to the shelving of fresh produce on store shelves. "Instead of moving food across state lines or importing it, you can offer folks locally grown produce," Rudel says.

Marketing Edge

The variety of strategies to boost efficiency goes beyond implementing technologies like light and boom irrigation systems, or mechanical pruning, shearing, and trimming machines. Growers are reviewing best practices and getting creative with marketing to stoke sales in the mature floriculture market.

"What I'm most excited about is the innovative ways that growers are going about marketing plants, such as doing collectible succulents that catch consumers' attention," Lindberg says. "There are decorative plants with containers that have edgy sayings, and they make excellent gifts."

Rebooting the image is driving sales, Lindberg notices. "The potted floral industry is doing quite well," she says.

The key for growers is to continue evaluating their operations for opportunities to reduce cost and improve efficiency, and to adopt technologies that will deliver a practical return on investment, Lindberg says. "The level to which they implement technology will depend on where they are in their careers and whether they are prepared to make large capital investments."

That said, Lindberg says, "Every operation needs to consider at least some strategies to improve efficiency to make sure they will be viable in five to 10 years and beyond."

Get Smart, Get Integrated

Think beyond irrigation system timers and individual tech upgrades. Growers that embrace truly smart tools can gain real control over lost time, materials, and money.

by Kristen Hampshire

The pressure points growers face are not anything they can control — cost and availability of labor, energy expenses, reduced margins. What are you going to do?

Well, there's technology. "Being able to deploy automation efficiently to reduce costs in whatever way possible helps offset those pressures," says Darren Ward, Manager, Business Planning and Commercialization at Vineland Research and Innovation Centre in Ontario, Canada.

One of the focuses at Vineland is helping greenhouses integrate technology into their production systems and conducting research projects.

Smart Irrigation Mimics Grower Behavior

Imagine an irrigation system that thinks and acts like you — a system that responds just like you would to plants' needs, if you could watch over every sprout of your inventory every minute of the day. This is true, smart irrigation, and it's so much more than greenhouse sprinklers on a timer. "Smart irrigation can actually capture the nuances of growers' decision making," Ward says.

Vineland Research and Innovation Centre developed an artificial neuro-network using machine learning and artificial intelligence (AI). Basically, the system marries greenhouse climate data with growers' own watering decisions. "We run a growing 'training' cycle to bring in data to determine how the grower is watering," Ward explains.

From this training cycle, the smart irrigation system uses data to "understand" watering decisions: how and when the grower applies water. Then, the system can reproduce growers' behaviors. Basically, it thinks and acts like the best horticultural pro in the greenhouse.

The system is designed for potted crops including ornamentals and herbs, and it's making a cost-savings impact. When Vineland studied the amount of time growers dedicated to scouting crops with the system in place, the center recorded a savings of more than 46 hours per acre, per year. "That's a significant amount of time the grower does not have to run around to see if crops need watered," Ward points out.

That's the direct labor benefit. There are other crop quality and consistency advantages. "The system takes on the behavior of the grower who 'trained' it, so if you send your best grower out on the training cycle, it will implement their decisions in the entire greenhouse," Ward says.

The system also produces a water and fertigation savings of up to 15 percent. "During the training cycle, the system will ignore or filter out any outliers or extraneous decisions, such as a grower erring on the side of caution in summer and putting in a little too much water in hot weather," Ward says. "The system isn't emotional or preventive. It's based on cold, hard data."

Water savings in these cases helps improve plant health, Ward says. "You can cut down on root-born diseases that happen when you over water."

For example, Vineland observed one crop of ornamentals that received irrigation through the smart system. "At quality control, none were rejected or sent back to the greenhouse for further growing," he reports. "And, the root structure of plants was better."

Ward says smart irrigation "is on the cutting edge," and Vineland is in the final testing stages of its system. It partnered with LetItGrow.org to implement the system in some of its greenhouses. The product is expected to go to market in fall 2019.

Ward says, "This type of system can make dynamic decisions, just as a grower would."

Integrating Systems— Analyze Before You Invest

Greenhouse technologies have evolved from "dumb, heavy machines" to smart, AI systems that capture and analyze data, predict and make decisions for growers. Plus, these systems can be controlled with the touch of a mobile app, says Omar Abdelzaher, Project Manager, Systems Integration at Vineland.

"Growers are looking to improve quality, reduce labor and waste, and increase efficiency, and that is what systems integration can help accomplish," he says.

With all the different technologies on the market, how can growers connect disparate systems and create a single control platform? One of the worst things that can happen is getting a system that turns out not to be compatible with an existing system, Abdelzaher says. "Solid upfront planning and assessment is the first step and worth the time."

ROI is always the key factor. Check into federal or provincial funding before making decisions. "They might save you a lot of equipment money and man-hours cost," Abdelzaher says.

Growers should identify their needs — what do they want the machine or system to do? "It's also very important to consider local service and support before you adopt a system or automation solution," Abdelzaher adds. "That way, when you need service, you can get quick response time to keep production running."

Really dig in to the operations and identify the production cost per operation for labor and energy. Identify the total waste percentage out of the production cycle. This will help reveal gaps where technology might be useful. "If growers don't have time to do these analyses, they should seek advice or a consultant's expertise," Abdelzaher advises.

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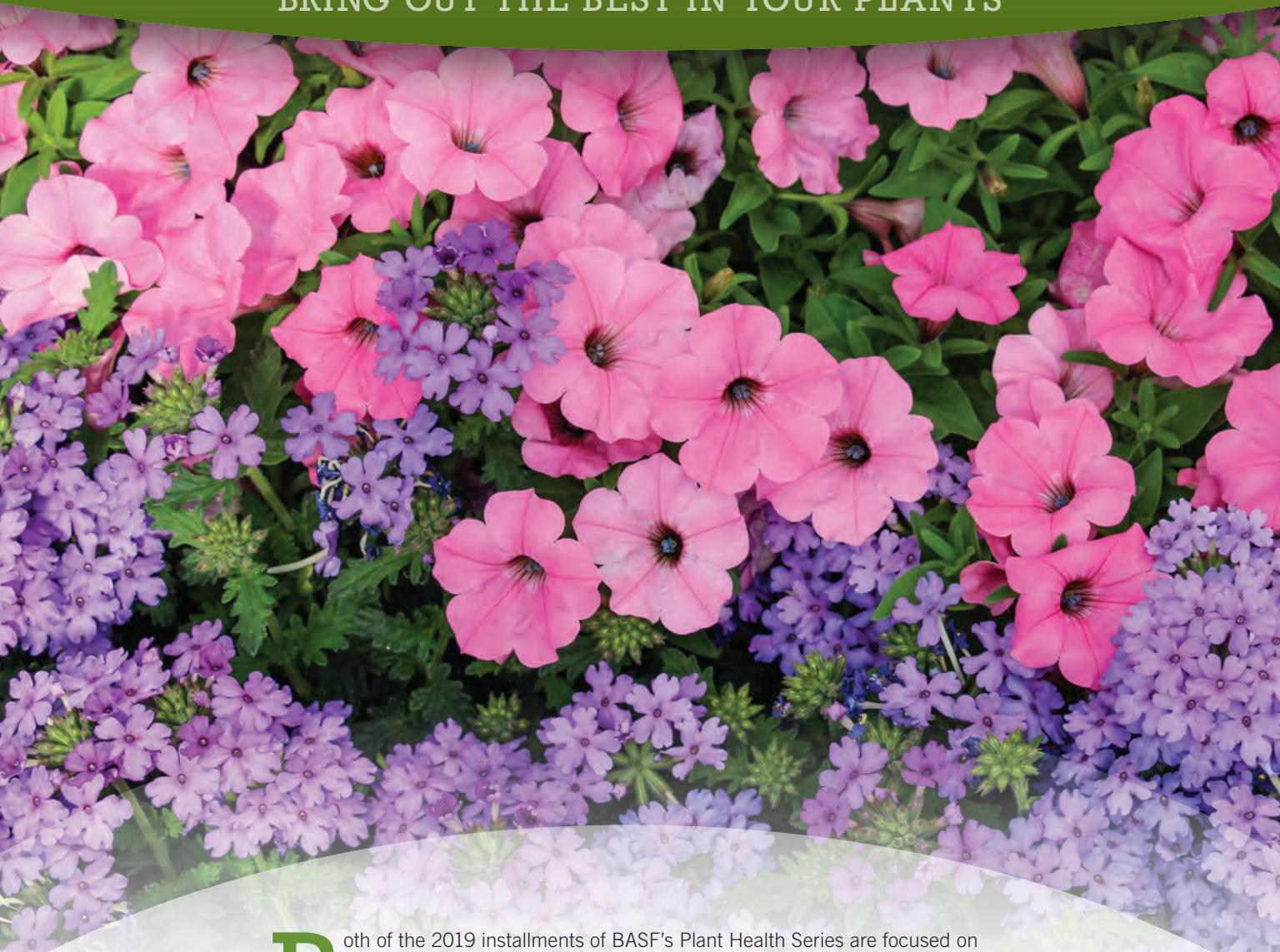


Both of the 2019 installments of BASF's Plant Health Series are focused on innovations that help growers produce healthier plants with less labor and fewer inputs. Labor and crop protection products have become pain points for growers in recent years. Regulations on both by government agencies have created difficulties, plus resistance to some key chemistries by certain pests are creating the need for more alternatives. This issue provides insight into cutting-edge technology that uses artificial intelligence to help grow plants. But the answers are not all technological. Sometimes it means going back to Mother Nature and using resources she's already provided: Biocontrols and biostimulants. All of these require some readjustment of tried-and-true growing practices. But growing isn't just for plants.

Biological and Conventional Tools for Plant Health — Better Together

We create chemistry for a sustainable future.

by Jen Browning

We're faced with a lot of choices and starting to recognize that the decisions we make today create our future. Professional horticulture is evolving; we recognize now that we don't have to choose between biologicals and conventional chemistry. We know now that the best growers rely on both.

In the not so distant past, we sifted ourselves into these two groups using words like organic, sustainable and beneficials or chemistry, conventional and pesticides — as though these things existed in two separate realms. Integrated Pest Management (IPM) is the practice that brings us back together; it's our scaffolding for managing pests in growing operations. Successful IPM programs blend biological and conventional tools, and they also use cultural and mechanical methods. So, what does that look like? It includes everything from scouting to releasing beneficials, to trapping pests, to excluding pests, to spraying. These activities create a foundation for strong and healthy plants, plants that sell through at higher rates and yield better returns. Who doesn't love a smaller cull pile?

Jen Browning, BASF Technical Specialist

So back to those choices we talked about. In commercial growing operations we manage pest pressure to deliver the best crop possible. That includes insects, disease, weeds, and even rodents. We're past the idea that if you use biological controls you can't also use chemistry. We know that most operations are already using IPM programs to reduce pressure and manage resistance. Now we're focusing on optimizing the tools and programs.

We're seeing the number of tools we have to choose from expand rapidly. Every year new products and techniques enter the IPM space to face their trial by fire in horticultural operations. There are new biological control agents (BCAs), pesticides and biopesticides, artificial intelligence, and monitoring systems. The articles in this edition of the Plant Health Guide touch on these ideas: new technologies, integration of controls, and optimization of growing conditions and practices.

There are three key elements to using these successfully: work with reputable sources, engage your sources with questions about your specific situation, and evaluate your implementation.

This year BASF is launching its first registered biopesticide, Velifer® Fungal Contact Insecticide/Miticide. This is an exciting time for our organization, taking experience gained in global markets to U.S. growers. We want to be among the leaders, offering comprehensive and integrated solutions for our customers.

Velifer is a versatile and complementary tool in our sustainable solutions portfolio. Together with Ventigra™ Insecticide, we've developed an integrated approach to management of mites, aphids, thrips, and beyond, through the whole growing season. We have tested both chemistries according to IOBC standards for compatibility with beneficial insects. Why? Because we are committed to both stewardship and integration, and standardized compatibility information is key to making it all work.

We've worked with growers who are brand new to biologicals and those who have used them for decades. We can credit the success of these operations to their ability to evolve and implement, and we all benefit from the many growers and other industry professionals who share their successful practices. Whether an operation is experimenting with beneficial nematodes as a gateway to using biologicals for the first time or is raising their own beneficials and growing banker plants, we've come a long way as an industry. It's easier than ever to find great solutions in the expanding palate of tools.

As you make your choices, remember that you don't have to choose a side: biological and conventional chemistries, BCAs, and our best cultural practices work best when they are deployed all together. Take that integrated approach to taming pests and use it to increase sell through rates and yield. Please enjoy the upcoming articles in this issue.

Articles in this edition:

- **Visual Aid – Imaging and AI Technology:** Robotic sensors and high-performance cameras create a data-rich, real-time visual and report of every plant in a grower's greenhouse.
- **Nature's Army:** Integrating beneficial insects into crop production can reduce pesticide use and elevate plant health.
- **Stimulating Plant Performance:** Biostimulants can help plants better absorb nutrients, deal with stress and even improve yields.

Jen Browning is a BASF Technical Specialist.
Learn more about other BASF ornamental innovations at **www.betterplants.basf.us**

Visual Aids — Imaging and AI Technology

Robotic sensors and high-performance cameras create a data-rich, real-time visual, and report of every plant in a grower's greenhouse.

by Kristen Hampshire

A grower notices yellowing on a plant in the greenhouse. The discoloration is slight — and it's difficult to determine whether the condition is worse than the day before. What if that grower could zero in on the plant in question and time-travel back a day or two?

"If you think about what happens today in a typical greenhouse, a grower might detect a symptom and he has to wait several days to see how it develops," says Matt King, chief technology officer at iUNU, which developed Luna, a computer vision platform that offers plant-level data analysis via sensors and high-definition imaging.

With Luna, the grower can "scroll back in time" and identify exactly what a single plant looked like 24 hours ago when it was imaged by the high-end camera that operates on a hanging-rail system.

Luna sensors provide data about plant growth, health, water needs, and more. *Photo courtesy of iUNU*

"Think of it as a scanner that builds a Google Maps of your greenhouse," relates Adam Greenberg, co-founder and CEO of iUNU. Luna's ultimate mission is to identify plant health concerns before they occur, and this early detection makes all the difference in improving greenhouse production, reducing labor, and elevating the quality of product a grower can offer retailers.

With this system, growers can identify potential problems through real-time visibility. They can respond faster and focus on the plants that actually need their attention. "You know the old adage, 'The best fertilizer is the grower's shadow,'" King says. "With this technology, growers can spend their time focused on the plants that need it."

Accurately Gauge Growth Rate

"The growth rate of a plant is like the heartbeat of a human," says King, relating what differentiates Luna technology from others.

"Having an actual, statistical, repeatable, objective measurement of growth is the best indicator we know of to determine the health of a plant," King says. "Growth rate is where diagnostics must start, and if the growth rate of a plant is right, if the flower count is right, then the plant is right."

The challenge is growers managing thousands or even millions of plants can't possibly track and recall millimeters of growth. Sure, they record and retain critical plant data — but how specific can a human be?

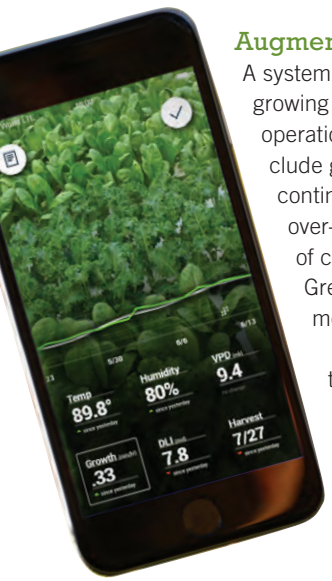
"You're relying on your eyeballs," King says. "There are some really good eyeballs out there, but they can't be everywhere at every time. But cameras are everywhere all the time measuring growth rate, and that foundational data changes decision-making processes and changes production processes."

Consider the task of evaluating plant readiness. By automating this process, the technology can identify which plants are ready

and where those plants are located in the greenhouse. The labor-saving benefit here is reduced scouting time. Plus, a digital flagging labor-management system allows growers to extend an existing flagging system to assign work tasks to a digital version of the same flags.

"Growers can let the computer do basic scouting, inventory tracking, and growth-rate measures so people can focus on what they are best at," Greenberg says.

Also, inventory tracking can be automated, and the ability to assure that plants meet retailers' specifications can reduce friction between sales and production staffs, Greenberg points out. Inventory counts and space utilization measurements are recorded automatically.



Augment Grower Capabilities

A system like Luna isn't designed to replace a growing team — it enhances talent in a growing operation. Early adopters of the technology include growers who are on a quest for continuous improvement. "You can get day-over-day continuous improvement instead of crop-turn-over-crop turn improvement," Greenberg says. "And, for growers with more than one facility, this is a no-brainer."

King adds, "Automation allows growers to have visibility directly at their fingertips." The technology gives growers the data necessary to make decisions before plant health declines. "That basic data, alone, is a fundamental game-changer," King says.

Luna cameras travel through the greenhouse on a hanging rail system, capturing images that are analyzed and sent to the Luna platform. Information can easily be viewed on handheld devices.
Photo courtesy iUNU

Technology + Engineering = The Future

by Kristen Hampshire

With the diversity of advanced technologies available for growers to save labor, automate processes, and control their greenhouse environments, there's one important human element that's missing from most operations: a greenhouse engineer.

"We've seen growers shut down possible technologies because they don't understand how to use them, or they don't use a system to its full potential" says Peter Ling, associate professor at The Ohio State University (OSU) Department of Food, Agriculture, and Biological Engineering. "And, if technology breaks down, they don't know how to fix it."

These are driving forces behind a new specialization at the Agricultural Technical Institute (ATI) in Wooster, Ohio. The two-year Greenhouse Engineering Technology specialization is the only one of its kind in the country, and it's a partnership between ATI and OSU. The degree merges studies in traditional horticulture technology, engineering, and new greenhouse technology.

"We want to train our students as technicians so they can help growers," Ling says. "They understand horticulture and technology. They understand how to use advanced computer controls to maintain an ideal environment for plants."

Greenhouse Engineering Technology students learn to use sensors, control strategies, actuators, and electro-mechanical equipment. They also work with smart irrigation systems, pesticide application equipment, and materials handling systems.

"To us, the key is for growers to understand the potential of the technology and to be able to use it to its full potential," Ling says, relating that one student in last year's graduating class had four job offers on the table. "We are getting a great response from the industry. It shows us that we need to train more students to supply the demand."

Nature's Army: Biocontrols

Integrating beneficial insects into crop production can reduce pesticide use and elevate plant health.

by Kristen Hampshire

A shifting mindset in the field is making way for nature's pest and disease army — special agents whose lifestyles center on eating the very insects that threaten crops. Biocontrols are "all-natural population regulators," explains Michael Brownbridge, research director, horticulture production systems, Vineland Research & Innovation Centre, Ontario, Canada.

Biocontrols are a preventive tool for growers who want to reduce the use of pesticides, or at least take a more targeted approach by eliminating broad-spectrum materials from their repertoire in favor of specific, low-residual products used as a secondary source of control. "If we reduce certain broad-spectrum pesticides, there is space for natural enemies to come into a crop and thrive," Brownbridge explains.

It's a different way of operating for many growers.

"We have to think about control in a totally different manner," Brownbridge says. "There aren't exact biocontrol alternatives for every chemical agent. You can't just extract chemical X from your program and replace it with Biocontrol Y. Using biocontrols requires a whole change of approach to get results."

A green lacewing larvae eats an aphid. Green lacewings, both larvae and adults (top left) are one of the most versatile beneficial insects, feeding on aphids, thrips, mites and other soft-bodied pests.

Growers are being forced to reconsider how they control pests and diseases because of regulatory pressure and plants' increased resistance to certain materials. Not to mention, consumers are demanding products without chemicals. They want to know what substances were used on the plants they buy at the garden center. Also, a widespread concern about pollinators and removal of neonicotinoids from the market means growers need alternatives to fight damaging pests.

Biocontrols are a viable solution. Brownbridge notes an exponential growth in the demand for these agents, and education so growers can use them effectively.

Ultimately, biocontrols give more power to the plant.

"It's an exciting area," Brownbridge says. "It not only addresses how we control pests and disease, but how we can make the plant a more active player in terms of its ability and capacity to reduce pests and disease."

Here are some factors to keep in mind when incorporating biocontrols into a pest and disease management control program.

Know the Crops — and the Enemies. Map out the lifecycle of crops and consider the entire year, not just a specific part of the growing season like planting or harvest. "Identify when certain activities happen and when specific pest control decisions have to be made," Brownbridge says. "When do issues appear? What has happened to the crop in the last five years?"

Because crops face different pest and disease issues, treat them individually. Also, consider the range of diseases and issues crops face. "Any crop is not going to have just one pest or one disease — you're dealing with a range of problems, so the key with biocontrols is to start small with one bullet-proof biocontrol, and then increase your use of these natural agents," Brownbridge says. "And make sure you know thy enemy. Understanding pests and diseases is important because the biocontrol agents we use are quite specific, and each will regulate a limited range of pests or diseases. There is no one-size-fits-all program."

Think Prevention. Biocontrols are most effective when introduced as a preventive measure. "You don't want pest numbers to reach a critical mass before you start using biocontrols," Brownbridge says. "They work to prevent pest populations from developing and to prevent diseases from getting out of hand."

For growers, this essentially means releasing biocontrols before pests are identified on crops. Brownbridge says it's often hard to find the pest or disease when there is a low incidence level. So, overall, you must have a very preventive mindset."

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Terra Nova Nursery in Oregon uses beneficial insects in its growing operation. *Photo: Robin Siktberg*

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Give Biocontrols Time. Suzanne Wainright-Evans of Buglady Consulting notices that many growers who try biocontrols and do not have immediate success consider them a failure. But when a chemical product they spray on crops does not work, "Ask the grower, 'Did you use it again?' and they'll probably say, 'yes,'" says Wainwright-Evans. They'll spray the same product over and over without getting results, but they're ready to quit after a hiccup using biocontrols."

As with introducing any product or process, implementing a biocontrol program takes time.

Wainright-Evans identifies a few key pests that are highly manageable with biocontrols. Those are spider mites, fungus gnats and western flower thrips. "I consider those bread-and butter programs," she says.

Indeed, there is a learning curve with biocontrol use. "You might go through two or three years of learning," Brownbridge says. "So, it's important to start small."

Consider Complimentary Chemistry. Biocontrols are effective prevention, but sometimes a pest or disease gets out of control before it is detected — and before a biocontrol can effectively manage the problem. Using biocontrols does not mean that synthetic products are off the table. "Sometimes, the conditions are such that a grower can get ahead of a pest or disease problem, and other times they need chemistry to control a problem."

Brownbridge says that products with a low-residual and narrow spectrum of control are the best accompaniments to biocontrols. "All chemistry will affect biocontrols to a greater or lesser degree, but some are more compatible than others," he says, adding that some new products that are being developed and registered are designed with this in mind.

Beneficial nematodes are one of the easiest ways to get started with biocontrols. They can have a big impact on thrips (above) and fungus gnat populations.

What will not work with a biocontrol program is broad-spectrum control products. There is a push to limit the use of these types of materials anyway. A grower that opts for a more targeted control program can use biocontrols in conjunction with complimentary products that will not interfere with nature's pest-and-disease fighters.

"If you have to use a product, just consider what you are using and understand its impact on your biocontrol program," Brownbridge says. "Having that knowledge in hand, understand the steps you need to take after you apply the material so you can reintroduce biocontrols after using the chemistry."

Stimulating Plant Performance

Biostimulants can help plants better absorb nutrients, deal with stress, and even improve yields.

by Kristen Hampshire

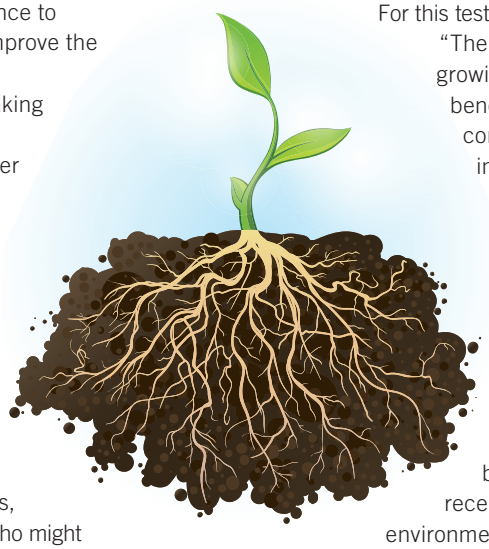
They stoke fertilizer uptake and can help plants power through drought. Some improve pest and disease resistance, others stimulate plants' natural processes, so they simply do a better job of using nutrients. In a lot of ways, biostimulants are like vitamins — not medicine. They can make plants more resilient, less susceptible to abiotic stress, and more likely to recover after wilting on the shelf. But they're not a be-all-end-all.

Technically, plant biostimulants contain substances and/or micro-organisms whose function when applied to plants or the rhizosphere is to simulate natural processes to enhance/benefit nutrient uptake, nutrient efficiency, tolerance to abiotic stress, and crop quality (European Biostimulants Industry Council). "Biostimulants give us a whole new suite of tools to improve plant performance and plant stress-resistance," says Neil Mattson, associate professor, plant science at Cornell University.

Biostimulants are not fertilizer. They are not pesticides, even if some will increase plants' resistance to harmful insects. Rather, biostimulants improve the way these inputs work.

"If we look at a biostimulant that is making fertilizer uptake more efficient, then that would not be applied in place of a fertilizer but in combination with it," Mattson explains. "You could reduce the amount of fertilizer you add to some degree because you added a product that helps the plant take it up."

Mattson refers to biostimulants as "another tool in the toolkit to make healthier plants that are more tolerant." And, considering the range of stressors plants face at every stage in their lifecycles, a little extra protection is positive for growers, greenhouse businesses, and consumers, who might have better success at home with a plant treated with biostimulants.



Applying Biostimulants

Application depends on the type of biostimulant, and Mattson identifies seven main categories:

- Humic and fulvic acids
- Protein hydrolsates and other nitrogen-containing compounds
- Seaweed extracts and botanicals
- Chitosan and other biopolymers
- Inorganic compounds
- Beneficial fungi
- Beneficial bacteria

Some biostimulants are applied as a foliar spray, and others are watered into the plant root zone. "Sometimes, repeat applications may be required," Mattson says. Growers should read labels carefully to determine the proper timing, rate, and application method before using any biostimulant.

Mattson has tested a number of biostimulants to observe their impact on plant health. One included the application of potassium silicate (56 ppm in CLF) to poinsettias, 12 days post-harvest. The plant that received a biostimulant application showed a marked improvement in vitality and overall appearance.

In another test, potassium silicate (silicon) was applied to plants that were then put into a controlled-drought stress environment of 102°F. After three and 4½ days, the plant receiving silicon was obviously healthier by its appearance. For this test, the plant received a 10 ml/L weekly drench.

"The addition of silicon to greenhouse plants growing in soilless substrates appears to be beneficial for certain plants under certain conditions," Mattson reports. Those conditions include: a present stressor like heat, salt, or biotic; and when the tap water, fertilizer, or substrate does not continually supply enough silicon as a contaminant. Also, he adds, "Silicon is not a miracle cure for every stress."

Create a Control Plot

Control plots are necessary so growers can compare crops treated with biostimulants with those that did not receive applications, Mattson says. "Consider environmental factors that may or may not lead to observed benefits," he adds.

And, keep records.

"Biostimulants are a large class of materials," Mattson says, adding that this can make them intimidating to some growers. But the potential for biostimulants to boost plant health and address issues like pest and disease resistance is promising, and growers are seeking new strategies for dealing with these issues. Mattson says, "Biostimulants are appealing to growers who are quite proactive at looking for ways to replace conventional controls."

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