GROWERTALKS

Features

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AI for Growers: Growing Plants Edition

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In October 2023, I wrote about ways growers can use generative AI tools such as ChatGPT or Gemini (formerly Bard) to make marketing tasks easier. Hopefully, you've tried some of the tips! (Read that article HERE.)

Now it's time to turn your attention to the ways AI technologies can and will impact the bread-and-butter of your business: growing plants. This is a rapidly changing and expanding area of agriculture with constant innovations and new opportunities opening up. Acceleration of computer processing power, and availability and improvements in machine learning are putting AI technologies for use in the greenhouse within view. It might be a long view, but it's within view! (And some of it is closer than you think!)

AI vocab lesson

The rest of this article will make a lot more sense when you understand these definitions. Think of this as something like "AI 201."

Data: All AI tools and programs run on data. In this sense, data can be anything: photographs, words, numbers, code. Labeled data is what it sounds like: photos or numbers or words that are categorized with meaning. In the case of numbers, it might be a set of bud counts for a potted crop at a certain number of days or weeks post sowing. For pictures, it might be something like "aphid damage on juvenile foliage of XYZ shrub."

Labeled data is much more useful than unlabeled data when it comes to training AI programs for specific tasks, but labeling data is expensive and time consuming. During the Q&A portion of the HRI webinar "In the Lab and the Landscape at the National Arboretum: Boxwood Genomics and AI Solutions for Blight Detection and Protection," scientist Fred E. Gouker mentioned that citizen science will likely play a role in making diagnostic AI tools more widely available, simply because of the massive amount of data that will be needed in order to create general use programs that allow, say, a home gardener to upload a picture of their plant that's in trouble and have a program "automatically" diagnose it. When it comes to creating programs for specific tasks, such as identifying nutrient deficiencies in a specific plant at a specific age, smaller sets of labeled data can be enough to train models. (Small compared to creating something like ChatGPT, but no less labor intensive to create.)

Data labeling: This is the process of classifying and categorizing data to be fed to the machine learning programs. (I secretly think when you do a captcha asking you to "select all pictures of stoplights" you're helping label data to be used in AI. "This is a stoplight.")

Machine learning: A machine (like a computer) is fed data (such as statistics from producing a specific crop of plants) and, using algorithms and programs, learns to recognize patterns and forecast outcomes without human

interference.

Supervised machine learning: This is machine learning with specific inputs to help the programs learn how to better recognize and classify data. For instance, feeding a specific AI tool 100 pictures of iron deficiency in petunias to “learn” what that looks like. Then, once the model is trained, it can be used to help identify iron deficiency in petunias. During the HRI webinar, Fred describes how the research group is working on this type of project with boxwood blight recognition.

Generative AI: These are programs like ChatGPT that have been trained on huge data sets—just about every word, picture, video, sound and bit of code available on the Internet—and they create new outputs in the same form. That type of AI is useful for creating things like your plant descriptions.

Predictive AI: This type of AI program has been “trained” on historical data such as order information, plant characteristics (for example: plant heights for an entire greenhouse full of a certain plant cultivar at a specific time such as 10 weeks post seeding), climate settings and water use, etc. And using defined algorithms and decision trees makes predictions for forecasting and programming decisions.

“You might also like” features in online shopping uses predictive AI tools. An example of that would be something like, “Someone who has ordered four tubes of watercolor paint, a brush and a collapsible water cup is also likely to order watercolor paper in some format.” In a field growing environment you might have a model that could predict future issues with crops based on what it’s “learned” from a combination of weather data and corresponding crop yield data.

AI opportunity: Problem identification

In plant growing, there can be all sorts of problems: pest damage, pest sightings, nutrient deficiencies, weed pressure, lack of water, too much water. The list goes on. As it stands today, most monitoring for problems is done the old-fashioned way: with human eyeballs and, possibly, manual data inputs that might or might not be used again. This takes a long time and significant manpower from trained individuals to scout for problems and there can be a high degree of error due to human interpretation.

What if all of this could be done by a machine? In an industry plagued with labor issues, AI tools trained to scout and then interpret data from scouting will be lifesavers. To find out how that would work, I spoke with Kyle Schempp, UAV pilot and Drone Application Specialist for Drone Tech Environmental in Michigan. The parent company of DTE specializes in conservation initiatives, including managing invasive weeds. They’ve put their data to work with AI technology and an FAA-certified drone operation to create both spot spraying and data collection programs.

“We fly the fields with the multispectral imaging camera, which takes thousands of images,” said Kyle. “Those images are downloaded into a program called Pix4D, which helps us create a prescription spray map.”

He explained the multispectral imaging camera to me: “It takes pictures that showcase reflections from different pigment types beyond what our eyes can see.”

We might look at a composite image and say, “That is a field of daylilies,” where an AI program trained with labeled data might analyze the image and produce a result along the lines of “Daylilies within these GPS coordinates are nutrient deficient in potassium.” (Would it be phrased that way? Probably not, unless the program included a generative AI model to write the finding in “human speak.”)

AI opportunity: Production planning & management

When does a crop require feeding? When does it need extra of one nutrient or another? When is a crop ready for showtime? AI tools are being built to help both identify and predict the answers to those questions. It’s already

happening in large-scale agricultural production. One such AI tool can monitor and identify stages of growth in winter wheat plants and then assist with decision-making for growing and harvesting.

In the paper “Dynamically Controlled Environment Agriculture: Integrating Machine Learning and Mechanistic and Physiological Models for Sustainable Food Cultivation,” the authors described their studies marrying historic data collection and interpretation techniques (sensors, weights and measures) with AI-powered tools (multispectral imaging combined with labeled data for machine learning) to allow for more accurate and comprehensive diagnostic and prescriptive information output.

In human-speak: We’ll be able to take our historical knowledge of plant growth characteristics and incorporate new information made available by more sensitive instruments and use AI models we (and by “we” I mean the scientists) have trained to generate ultra-specific care plans, production calendars and maps, and more.

AI opportunity: Forecasting

After gigabytes of situation-specific data have been uploaded to an AI model, and the model is trained, it’ll be able to start predicting that, given a certain set of weather conditions, a crop might be at risk of developing certain problems. Anyone who’s grown a particular crop for a long time has personal experience and can probably already predict certain potential problems. What happens when that knowledge retires with the person that has it? AI to the rescue?

What’s next?

The horticulture industry is going to need individuals that can work with this AI technology at all stages of development, from research to implementation. If anything, forthcoming advances in AI will make it more important than ever for our field to recruit new minds interested in furthering these types of scientific advancements … and for the rest of us aging horticulturists to start learning about all of it! **GT**

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