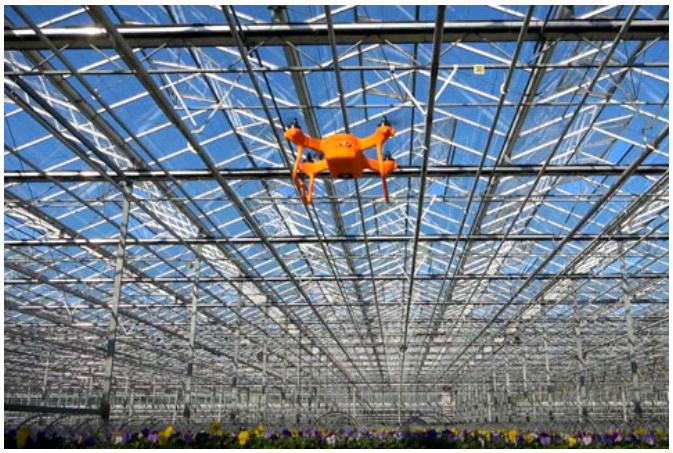
insideGROWER

FEATURES

2/1/2025

Drones? Or Data?

Chris Beytes



There are more than 300,000 drones flying over row crops, field crops and orchards around the world, monitoring stress, scouting for pests and spraying pesticides. Replacing—or at least complementing—both ground-based spraying and crop dusters, the agricultural drone market is worth $6 billion today and is expected to grow to $24 billion by 2032.

But that's outdoors, where there are many acres of crops to cover and plenty of space in which to fly. What about indoor agriculture? Can you fly a drone in a greenhouse? Should you fly a drone in a greenhouse? Or are there better alternatives?

Pictured: A Corvus drone at Baas Potplanten Nursery in the Netherlands, where they measure seed germination and the size of mums. Dieter Baas said, "We scaled up significantly last year, with more areas to cover."

There are at least six reasons to get a birds-eye view of your crop (besides taking impressive video footage, that is):

- to count (inventory, harvest forecasting)
- to measure (plant size, leaf volume, seedling germination rate)
- to analyze (drought, nutritional deficiencies)
- to scout (for pests and diseases)
- to apply (pest control remedies)
- to pollinate.

Some of these are accomplished using various visible light, multispectral or thermal cameras/sensors that gather the data about the crop and send it back to a computer (on-site or cloud-based) for analysis. Pest control drones have onboard spray/release containers. (One drone, called PATS-X, is itself the pest control, using its props as weapons). You program a drone to fly itself autonomously through your greenhouse,

carrying the proper sensors, and the billions of bits of data it gathers get crunched by computer, giving you an actionable to-do list.

Sounds simple. But is it? Corvus Drones (corvusdrones.com) in the Netherlands believes it is.

“Drones are the new human eyes in greenhouses, but faster and more accurate,” said Corvus’ developers. “Our dream is for every grower worldwide to use a drone. One that is so smart that it does all the work. That way, every plant in every greenhouse is monitored daily.”

Corvus’ small drones are launched with a click of an app on your smartphone, and it captures images of the crop within 20 minutes. Data is sent to Corvus’ cloud, where it’s analyzed via “advanced AI algorithms” per your requirements, then a report is sent to your inbox. Users include rose growers, who get flower bud counts for harvest forecasting that Corvus said is 90% accurate up to two weeks in advance of harvest. A pot and bedding plant grower uses Corvus drones to evaluate seedling germination. A potted orchid grower is running a pilot program to scout for diseases. And a lettuce operation is monitoring growing gutter alignment, crop growth, pests and diseases, and harvest weight estimates. Corvus charges for the service via “subscription plans” of three months or one year, or by special projects.

Pictured: AgriData Innovations’ Smart-Eyes sensors on a boom flying over the top of chrysanthemums. They can also ride on existing heating pipes.

Another drone-based crop analysis provider is CropScout, from Si-Ware Systems of Menlo Park, California (www.si-ware.com/solutions/cropscout). Founded in 2004 as a semiconductor company, Si-Ware has 20 years of experience providing technology, so they’re not a startup. One of their products is called NeoSpectra, a handheld, lab-quality NIR (near infrared) spectrometer. CropScout uses the same technology to capture high-resolution images of crops in the greenhouse, and their AI-driven smart image processing looks for early signs of water stress, nutrient deficiencies and pests. “CropScout’s autonomous operation eliminates labor-intensive monitoring,” they said. “Through early detection and correction of issues such as nutrient imbalances, pest infestations and environmental stressors, the system helps prevent crop losses, maximize yields, and optimize the usage of valuable resources throughout the plants’ growth cycle.”

While sounding promising, CropScout is not yet on the market; last November, Si-Ware invited early adopters to request participation in the first trials of the technology.

We mentioned pollination as one potential use for drones. Polybee of Singapore (polybee.co) offers several camera-and-AI services for CEA, including digital phenotyping, precise yield estimation and autonomous pollination. Their drones can actually fly among the high wires of a tomato greenhouse, they said—something we didn’t think was feasible or practical. They claim 99% accuracy on fruit count and less than 5mm of error for fruit size measurements, which is impressive. We suspect the technology could be deployed without a drone, however; instead using the harvest trolleys already in use. However, Polybee’s pollination strategy does require the drone. They said, “We apply our in-depth understanding of the fluid-structure interaction between airflow, mechanical properties of flowers, and the efficacy of pollination as a result of the vibratory

motion," all achieved from the downwash from the propellors of the tiny "nano drone."

Earlier, we mentioned PATS-X. PATS (www.pats-drones.com) is a Dutch company that uses stationary cameras to monitor the greenhouse for flying insects. The company's software helps the grower track pest populations. The software and camera system can also deploy a palm-sized "bat-like" drone to attack pests, using its propellors to kill the pest on contact. It too, is still in the testing stages on a "variety of crops" in the Netherlands and Belgium.

Navigating the greenhouse air space

Anyone who has flown a drone knows how temperamental they are. Despite GPS navigation and obstacle avoidance, one slight breeze—or an unexpected irrigation boom—and the drone is toast. Autonomous programmed flight, guided by LiDAR and various types of markers in the greenhouse, eliminates human error, but doesn't ensure precision.

Pictured: Spyder, a cable suspension technology from Neatleaf, can "fly" over the crop to take measurements.

Dr. Peter Ling of The Ohio State University worked with grad student Aditya Raj on a master's thesis in 2021 titled "Aerial Sensing Platform for Greenhouses," testing the feasibility of drones for pesticide applications and other greenhouse uses. The researchers found that, given the available technology, it was challenging for the drone to fly at a precise altitude/elevation above the crop, which is required for accurate, repeatable imaging and data-gathering. It was also challenging to stitch together the resulting images, especially if they weren't identical in size. But Peter believes greenhouse drone technology "has a lot of potential."

At Delft University of Technology in the Netherlands, they are testing drone navigation inspired by insects—which they think take "snapshots" of their location every so often, then compare their surroundings to the snapshot to navigate back home. Too few snapshots and you get lost. Too many and you consume too much computer memory.

Sensors without drones

Do we really need a drone to deploy crop sensors in a greenhouse? Two former drone researchers, William Simmonds and Lucien Fesselet, co-founders in 2015 of Applied Drone Innovations, now AgriData Innovations (www.agridatainnovations.nl), say no.

The duo, whose company started as an engineering school project, realized during testing that their added value did not lie in drones, but in data. This shifted their focus to developing "smart eyes" and AI to obtain efficient and reliable information from the crop. Instead of drones, they move cameras via monorails using existing heating pipes, or on spray booms. And their smart eyes can work in a vertical farm where crops are stacked too closely for drones to fly.

PATS also offers a non-drone technology: stationary scanners called PATS-C that monitor for airborne insects—basically scouting for you, at least for flying insects. They've been testing it on tomato and strawberry crops, as well as cut flowers and potted plants. At Kwekerij het Westland in the Netherlands, they're scanning for tomato looper on bell peppers, in conjunction with the release of the parasitic wasp Trichogramma achaeae for control.

Another non-drone pest scouting technology from PATS is Trap-Eye, which mounts a yellow sticky card in front of a camera, so the camera and computer can automatically identify and count the insects stuck to them. You hang it via magnets on your greenhouse columns.

There's another drone-like technology that could be more foolproof than drones, and that's SkyCam, the cable system suspended over stadiums and arenas to provide never-before-seen angles of the event. The company Neatleaf, founded in 2020 and with offices in San Francisco and Munich, has adapted cable suspension technology to the greenhouse, "flying" a cable box-sized "Spyder" camera/sensor unit over the crop, taking temperature, humidity, CO2, leaf temperature, light intensity and other readings. It can remain one height above the plants, or it can zoom down closer into the plant canopy. It's mounted to the greenhouse or vertical farm infrastructure, takes the readings and uploads the data to the cloud for access from anywhere. It uses proprietary AI technology to quantify plant health and forecast yield based on the collected data. Spyder was in development for four years and has been deployed in the field for two years.

The upside of a technology like Spyder is that it doesn't need batteries, it can carry a heavier payload, and its track seems more crash-proof and repeatable. The downside of this and every other non-drone technology is the amount of equipment and the number of cameras/sensors you'd need—one per bay, most likely.

While drone use in the greenhouse is in its infancy, and may never mature to widespread acceptance, there is one application that makes sense today: shade. Drohnen Agrar Service in Germany uses an XAG P40 agricultural drone to apply ReduSystems' shading compound and shade remover to greenhouses quickly and safely. And no AI or algorithms required!