Researcher explores drone-driven crop management

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Penn State Extension dairy and crop educator J. Craig Williams tests drones to determine possible uses of the technology for such purposes as observing pest control and fertilizer application patterns. Credit: Tom Flach

A flock of pigeons flies over the soybean field where J. Craig Williams is standing. He reaches down and rips off a brown pod from one of the withered plants and splits it open. Grabbing a tiny bean between his calloused fingers, he flips it up into his mouth and bites down. "You want them to crack or pop between your teeth," he said while chewing on the brown bean. "That's how you know when they're mature and ready for harvest."

Williams, a Penn State Extension dairy and crop educator, is experimenting with soybean plots like this one in rural, northern Pennsylvania as part of a $9,200 grant provided by the Pennsylvania Soybean Board. When ready, the matured beans from his test plots will be harvested to determine each variety's yield and then sold to a local grain mill as soymeal for livestock.

But the pigeons aren't the only things flying over Williams' head. The buzzing sound of a small hobby plane pierces the country calm as the tiny aircraft moves back and forth across the field in an organized flight path. Williams is operating it remotely from the ground through his iPad. "We're assessing drones to see how they might be used in agriculture," he said.

Williams, who initiated the drone evaluation as a part of the overall soybean grant, is testing the drones to determine possible uses of the technology for such purposes as observing pest control and fertilizer application patterns. According to Williams, monitoring these types of things from the air can help growers with crop management decisions.

Officially known as Unmanned Aerial Vehicles, or UAVs, drones can be used in agriculture to survey and monitor large tracts of land, allowing farmers to get a bird's-eye view of their crops.

"There's a lot of potential for drone use in agriculture today," said Williams. One of them is using the vehicle to do flyovers, using the attached cameras to check on crop progress. "By enabling farmers to look straight down on their field, they can determine if there was a mechanical problem with the planter that repeats itself across the field, see if parts of the field have a different soil type that calls for additional nutrients to be added to the area or perhaps find a wet area that needs tile drainage."

Drone vehicles range from low-end quadcopter planes with GPS technology and standard point-and-shoot cameras to sleek, high-end, fixed-winged crafts equipped with infrared cameras, sensors and other technology. Each is remotely controlled by a pilot on the ground.

Williams is using one of the lower-end models to conduct flyovers and take pictures and videos of various plots of soybean seeds the farmers are testing. His 22-inch-long drone is made from lightweight plastic to allow for increased maneuverability and is equipped with four rotors that enable it to hover 3 feet into the air from its standing position before taking flight. By simply touching the iPad's display, Williams is able to control the craft's movements up or down and forward or backward. Cameras located on the front of the drone wirelessly stream field footage directly to his iPad screen as it's flying. Using the video and images derived from the drones helps Williams to observe patterns in the plant growth as well as the way the different varieties of seed are taking in nutrients.

"We've followed these plots all the way from planting to harvest and have been looking at the green color of the soybeans from when they are in a vegetative stage to the point where they are getting ready to harvest and we can see the gray-brown colors of the varieties," said Williams.

While drone technology is still on the verge of transforming agriculture by helping farmers oversee millions of acres of their crops, it also has the potential to transform other industries as well. Amazon recently announced plans to launch a drone-operated package delivery service, Google is considering using drones to provide wireless Internet access to remote locations and NBC used drones during the 2014 Winter Olympics in Sochi to capture new camera angles during downhill skiing and snowboarding events.

But until the Federal Aviation and Administration (FAA)—the agency

that regulates and oversees all aspects of America's airspace and aviation system—approves commercial drone use, all of this progress is in a holding pattern.

Since most agriculture operations span large distances and are free of privacy and safety concerns that halt the use of drones in heavily populated areas, FAA rules have restricted their civilian use to recreation and certified research projects. But once the commercial regulations are in place, the sky's the limit for farmers. In fact, the Association for Unmanned Vehicle Systems International, the trade group that represents producers and users of drones and other robotic equipment, predicts that 80 percent of the commercial market for drones will be for agricultural uses.

And that's good news for Pennsylvania soybean growers who plant nearly 500,000 acres of soy each year.

According to Williams, soybean crop monitoring is usually done through visual inspections by farmers simply walking their fields to look for crop stress and other damage caused by insects and disease. However, due to the sheer size of some fields, Williams says it's difficult to monitor problems strictly from the ground. Such infestations as the soybean cyst nematode, a plant-parasite that infects the roots of soybean plants, can go undetected for weeks, causing thousands of dollars in losses in the process. The center of the field could be overcome with weeds and a farmer wouldn't know until harvest time.

Drones can augment crop management efforts by providing a snapshot of the entire crop's condition from a 300-foot view in high-resolution images, which can later be stitched together to make a mosaic that the farmer can use to make decisions on when and where to spray pesticides or apply herbicide treatments.

"Drones can help propel precision agriculture into the future, and today's farmers are more inclined to embrace the technology if it will help them make better decisions about how to manage and care for their crops," said Williams.

However, operating their own drones and weaving all that data together might be too much of a learning curve for some growers who prefer to leave the use of the technology to the experts, so they can concentrate on farming their fields.

So until commercial drone services are approved and widely used in agriculture, Williams will continue to do flyovers, scout fields and give feedback on the vehicle's performance as a service provided by extension. He hopes his small-scale evaluation of the tiny aircraft will enable him to conduct demonstrations and provide educational workshops on drone use through extension's education network so farmers can learn how they might adapt them to their farms.

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