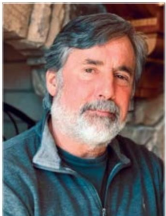




Laser Weeder. Photo courtesy of Carbon Robotics

Eat Your View



By ROBERT TURNER

## Is This the Farmer of the Future? Not Really; It's All Happening Now

Small growers, particularly organic growers, are acutely aware of what's going on in every row of their gardens and fields. Large farms,

where most of our food comes from, don't have that kind of visibility. That's all changing.

Many people would prefer that commercial farmers not spray chemicals at all. But those large farms would argue that food production would be drastically reduced if they didn't use chemical fertilizers to improve yields and applications to control weeds and pests, driving up food costs and leading to food shortages. It's a debate that's been raging for more than half a century.

New technologies may help us wean farmers off the chemicals because the problem is not just spraying but serious over-spraying. According to some research, industrial farmers often use twice as much nitrogen fertilizer as necessary, with a lot of that leaching into our waterways, creating algae blooms and other problems. The overuse of pesticides is leading to superbugs now resistant to everything in our chemical arsenal. A better

understanding of what's going on in specific sections of each field may lead to better targeting through variable rate application technology, guided by satellite maps and GPS. This could mean a significant reduction in chemical inputs, which is better for the environment and a big cost savings for farmers.

New satellites using multi-spectral sensors and imaging, but no bigger than a bread box, can see something the size of a bread box on the ground, and can tell a farmer about a problem in a section of a field long before the farmer can see it, whether that problem is related to water, nitrogen or pests.

Artificial intelligence (AI) and what has been called "precision agriculture" represent an ongoing transformation of farming that includes digitalization and automation of farming decisions and tasks. Digital technology promises to be an important part of the solution to the many challenges facing US farmers, including rising production costs, climate change and labor shortages.

According to the USDA Economic Research Service, automated guidance, or GPS-guided auto-steering tractors, has increased sharply in the past 20 years, with well over half of the acreage planted to field crops now

using the technology. The GPS technology limits row overlapping and reduces fuel consumption and seed and chemical input costs. It also reduces greenhouse gas emissions and soil compaction.

New high-tech sensors located in the field, on drones and satellites flying overhead, give farmers a much clearer picture of what's happening in real time. When integrated with digitized soil maps, based on detailed soil tests and sensors across the farm, farmers can track and better manage the application of fertilizers, pesticides and water using "variable rate" seeders and sprayers linked to the farm equipment. That also leads to fewer chemicals used, reduced costs for farmers and higher yields. And importantly,

environmental impacts of farming.

New advances in AI and laser technology may be even more promising because they reduce the need for harmful chemical pesticides altogether, which is good for birds, bees, butterflies and humans. Laser-weeding robots are working in the vegetable fields of California right now.

At a cost of about \$1.2 million, the new Laser Weeder built by Carbon Robotics has replaced about 30 workers doing the back-breaking work of pulling weeds at an organic farm in California called Braga Farms. How does it do it? Not by pulling the weeds but by zapping them with short bursts from a bank of lasers mounted underneath the machine.

The key to the technology is the machine's AI ability to learn and identify a weed versus a crop plant and to zap just the weed. The robotic machine can zap weeds that are even too small for a human to grasp and pull in a burst that lasts for just milliseconds. It's the rapid heat energy from the laser that kills the weed, and the tiny sprouts quickly burst into smoke and flame under the intense laser beam flash.

Racks of servers in the Laser Weeder have learned to recognize up to 40 crops and 80 types

of weeds, and it's still learning. But can it one day learn to identify a good, helpful bug from a bad one, and then just zap the bad one? A weed and bug laser zapper does not exist yet, as far as I know, but I think it may be somewhere in our future as AI and machine learning advances.

As with all technologies, costs will likely drop as adoption and competition increases, and as more information and web-based tools hit the internet. So strap on your virtual reality goggles, uplink to satellites, field sensors, digital soil maps and your robot tractor, and get farming.

Robert Turner is a farmer and author of Lewis Mumford and the Food Fighters: A Food Revolution in America. Learn more at EatYourView.com.



Robot Farmer. Matthew Turner, artist

precise applications of fertilizers and pesticides will greatly reduce nutrient leaching and chemical run-off that threatens our waterways and environment. The technology will also delay the inevitable pesticide resistance and the genetic adaptation of new superbugs while it improves water conservation (a huge concern for Western states).

The internet and Internet of things (mobile devices, AI and predictive analytics) will improve the collection, exchange, analysis and access of digital content inside the farm gate. The wireless transfer of data, aerial imagery and soil maps between farm equipment, connected devices and the cloud is here. These technologies hold great promise for improving the