



PRECISION AGRICULTURE SIMPLIFIES HARVESTING OF UNUSUAL FOOD CROPS

The adoption of precision-agriculture equipment by farmers nearly always makes sense over the long term, but the timing for such purchases must be right. After all, farm equipment is expensive and designed to last for decades, so new equipment purchases are largely dictated by how far along current equipment is in its expected life and depreciation cycle.

Some groups — including Tennessee-based nonprofit AgLaunch backed by the USDA and the Economic Development Administration or EDA — aim to make agriculture automation more economically accessible and practical for farmers seeking to boost their fields' productivity. Top priority is helping farmers cash in on specialty crops for which consumers will pay more. The location of AgLaunch is strategic, as Tennessee is in the so-called mid-south region of the U.S. that doesn't face the water and arable-land challenges of other areas of the country.

Absolutely central to the efforts here is precision agriculture, also called smart farming.

That's because specialty crops necessitate customized handling that's reliant on either lots of manual labor or lots of automation that's specially engineered for said crop. Consider the harvesting of blueberries, strawberries, and notoriously delicate raspberries. Now, machine builders are beginning to supply equipment specially designed for handling these fruits. Such automated harvesting complements manual labor directed towards more cognitively involved and oftentimes engaging tasks.

No wonder that when the timing is right for a specialty-crop farm to procure all-new equipment, fully robotic harvesters with GPS-based navigation are an [increasingly common](#) choice.

POWER-TRANSMISSION AND MOTION-CONTROL COMPONENTS OF AUTOMATED HARVESTERS

The mechanical components and motion controls of industrial machinery for discrete automation are a highly suitable fit for adjustable farming implements, especially those that execute slicing and picking actions. Consider the special case of plant-cutting operations. Prior to the actuation of any blades, automated equipment for such tasks often employs machine-vision cameras and software for scanning operations. These:

- ✓ Identify whether a plant is suitable for cutting, ascertaining whether a fruit is ripe and ready for picking, for example.
- ✓ Locating the target plant section in three-dimensional space so that the slicer and/or other end effectors intercept the plant at the correct location(s).

The moment these tasks are complete, motion controls can command the involved actuators and end effectors to spring into action and execute the cutting operation.

Of course, conveyors and other material-handling equipment not dissimilar to that used in industrial manufacturing have been used in farming for decades. These motion subsystems (dominated by hoppers, gravity-based sorters, and power transmission assemblies) are typically found downstream from operations performed on live crops and its soil. Transporting already-harvested yields is relatively straightforward.

Requiring far more precision (and in fact, full servo positioning control) are picking and harvesting operations. These and more specialized operations at the farthest reaches of equipment demand precision designs.

Consider new efforts to automate the harvesting of asparagus. Traditional asparagus harvesting is an involved manual process that (due to its numerous steps) can be exceptionally costly. In fact, required labor is the primary reason asparagus is so expensive. What's more, variability in the asparagus stalks' rate of growth demands many passes over fields over the grow season to assess, tend, and painstakingly cut only individual plants that have ripened.



Automated coffee-bean harvesting coffee as on this farm in Brazil boosts crop profitability and quality. Image credit: Alf Ribeiro



Harvesting asparagus is an exceptionally complicated task. Automated equipment could make this and other special-process crops more profitable. Image credit: Markz

So an international consortium has collaborated to develop [asparagus-harvesting GARotics](#), a robotic vehicle employing machine vision to identify, cut, and gather green asparagus at top ripeness. The robot delivers high throughput with a cutting toolhead capable of making strokes at 1 m/sec. This allows sufficiently fast coverage of crop-row spans, and far outperforming first-generation equipment that couldn't work much faster than teams of human harvesters.

More specifically, twin cutting heads on the harvester's undercarriage that independently travel across crop rows on [SL2 stainless-steel linear guides](#). The vee guide wheels of Bishop-Wisecarver SL2 linear guides push away field dirt; an ac gearmotor powers a belt drive (based on HepcoMotion® [DLS linear actuators](#)) to deliver speeds to 1.4 m/sec or (with a specialized gearmotor) 5 m/sec.

Complicating the design of the GARotics automated harvester is how the crop is grown in environments that include hot, cold, dusty, and wet conditions. So, the robot (and all its subsystems) needs to withstand an array of harsh conditions to run 24 hours at a go in open fields. Here, Bishop-Wisecarver® motion components and subsystems (incorporating many lubricated-for-life and corrosion-resistant stainless-steel subcomponents) fit the bill. Known in the industrial-automation industry for their ruggedness, the BW systems also impart high-speed actuation to the harvester to maximize harvesting efficiency of a decidedly fragile vegetable. That is a top objective of asparagus farmers who aim to satisfy increased demand for asparagus.

Bishop-Wisecarver® linear-motion components

help the GARotics end effector maneuver around unripe asparagus stalks (without bumping into them or harming them) to move shears into position to cut stalks ready for the taking.

More specifically, Bishop-Wisecarver® useful for this and other automated harvesters include guided linear stages with pre-integrated rotary-to-linear mechanical drives as well as multi-axis solutions and custom subassemblies.



New asparagus harvesting equipment incorporates SL2 stainless steel linear guides, PRT2 ring and track systems, and DLS belt driven systems (complete with motor and controller) from Bishop-Wisecarver.

HepcoMotion® SL2 guides from BWC come in standard lengths to 4 m and allow butt joining for longer strokes. Where automated harvesters must swing in an arc around plants (or travel complex curved paths between them) [HepcoMotion precision ring and track system \(PRT2\)](#) curved linear-bearing assemblies featuring the same stainless-steel self-cleaning vee guides as other BW products, are suitable.



Linear and rotary motion-guidance and actuator solutions from Bishop-Wisecarver help improve agriculture profitability for faster ROI on farmers' investments in automation.

In fact, PRT2s on the GARotics design move grippers and cutting heads through curvilinear motion as they're lowered into harvest position. The specialized motion lets the assembly slip into even very small spaces between adjacent asparagus stalks. Then only harvest-ready stalks are gripped and cut. The cycle ends with the PRT2 and SL2 making a return stroke to deposit freshly cut stalks on a conveyor belt that transports the vegetables onward.

Other smart equipment complements automated harvesting

Of course, harvesting is just one operation associated with one season of crop tending. Automation is also useful for the planning stages of farming, especially those associated with analyzing long-term field health as well as deciding where and how to plant seeds. Now, some automated soil collectors can drill holes in soil with linear actuators to capture samples for analysis. In contrast with manual methods (requiring a farmer or farm worker to execute this job with a shovel) smart farming equipment can complete this task more quickly. Plus, in situations where arrays of samples must be collected for a full field profile, GPS-guided and linear-actuated systems are more precise.

Bishop-Wisecarver® is the exclusive North American distributor of HepcoMotion® linear-system offerings. For more information, call Bishop-Wisecarver at (925) 439-8272 or visit www.bwc.com.

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