Developing Automation and Mechanization for Specialty Crops: A Review of U.S. Department of Agriculture Programs

A Report to Congress

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What Is the Issue?

At $64.7 billion, specialty crops comprised one-third of U.S. crop receipts and one-sixth of receipts for all U.S. agricultural products in 2017. Many specialty crops are labor-intensive in production, harvesting, or processing. For example, harvest for many specialty crops requires workers to accurately distinguish ripe and unripe fruits and vegetables and gently pick, sort, or package the fruit or vegetable by hand without damage. A long-term decline in the supply of farm labor in the United States encourages producers to select less labor intensive crops, invest in labor-saving technologies, and develop strategies to increase labor productivity. Title VII (Research, Extension and Related Matters) of the Agriculture Improvement Act of 2018, includes a request in Section 7610 to review programs of the U.S. Department of Agriculture (USDA) that affect the production and processing of specialty crops to be utilized by the Secretary of Agriculture to develop and implement a strategy to accelerate the development and use of automation or mechanization in the production or processing of specialty crops.

What Did the Study Find?

USDA has six programs in the Agricultural Marketing Service (AMS), the Agricultural Research Service (ARS), and the National Institute of Food and Agriculture (NIFA) that, among other objectives, support the development and use of automation or mechanization in the production and processing of U.S. specialty crops. From 2008 to 2018 these AMS, ARS, and NIFA programs funded $287.7 million (nominal) toward 213 projects to develop and enhance the use of automation or mechanization in specialty crop production and processing. Projects covered a broad spectrum of technologies, including job aid/machinery automation, machine learning/data analysis, mechanical harvesting/processing, precision agriculture, remote sensing/drones, and sensors.

Funding amounts, projects, and technology categories are listed in a program inventory contained in an attachment to this report. Each identified program is designed differently to achieve unique objectives, although each program identified addresses the development and use of automation or mechanization in specialty crops in some form. The diverse purposes, origins, oversight, and funding mechanisms of these programs carry implications for how research

areas are prioritized and funded. For example, some programs are focused specifically on specialty crops while others include a broader set of agriculture sectors. In many cases, the structure of the program precludes determining whether demand for program funding exceeded funds available.

USDA has three programs in Rural Development (RD) that support the infrastructure needed for adoption of automation or mechanization. The programs in RD were targeted toward rural infrastructure that supported or enabled the automation or mechanization technologies to function. From 2010 to 2018, RD funded $3.4 billion (nominal) toward 280 digital infrastructure projects that facilitate the use of automation or mechanization in specialty crop production and processing.

Projects in the inventory represent multiple stages of research from the development of component parts, to working prototypes, to field trials, to integrated commercial technologies. Information on the extent of technology adoption was not available. Ultimately, adoption will depend on economic and behavioral factors unique to individual producers. For example, adoption of a new harvester technology that requires orchard redesign, while labor-saving, may not be feasible in the short run. Likewise, in an industry with a limited number of potential users or tight profit margins, returns on investment in research and development may seem low.

Going forward, new Federal programs may provide other funding opportunities to accelerate the development and use of automation or mechanization in the production or processing of specialty crops. For example, the Agriculture Improvement Act of 2018 authorized $50 million annually from fiscal year (FY) 2019 to FY 2023 for a 5-year pilot program: Agriculture Advanced Research and Development Authority (AGARDA). Funding must be appropriated before awards can be made. This program aims to achieve multiple objectives, with priority to projects that accelerate the advanced research and development of qualified products and projects that address critical research and development needs for technology for specialty crops, or that prevent, protect, and prepare against intentional and unintentional threats to agriculture and food.

How Was the Study Conducted?

With the help of the USDA Office of the Chief Scientist, ERS researchers worked with national program managers at USDA agencies to develop an inventory of projects and programs that directly accelerate the development and use of automation or mechanization for specialty crops between 2008 and 2018. With project timelines ranging from 1 to 5 years depending on the program and agency, the time period covers multiple rounds of project funding with enough time for early projects to have yielded results. Projects were assigned to one of six categories to describe areas of research: job aid/machinery automation; machine learning/data analysis; mechanical harvesting/processing; precision agriculture; remote sensing/drones; and sensors.