REDUCING LABOR AND ADVANCING PRECISION AGRICULTURE THROUGH AUTOMATION

ARS advances labor-saving tools and technologies to aid in crop and livestock breeding and production, improve preharvest and postharvest processing, and enable nondestructive quality assessment and grading of commodities. ARS researchers have developed precision irrigation techniques and instrumentation, and made advances in technology, automation, informatics, and remote sensing. These cross-cutting efforts—which advance agricultural science, help the industry overcome labor shortages, fine-tune management decisions, and conserve resources while meeting growing demand for food—are highlighted by the following accomplishments in 2021.

New precision management tool optimizes cotton producer decision-making. Quickly and accurately documenting cotton crop emergence allows a grower to identify problem areas in fields and replant if needed. The small size of newly emerged plants makes them difficult to identify with remote sensing, and the time required for extensive data processing to accurately detect them often prevents remediation based on the measurements. ARS researchers in Portageville and Columbia, Missouri, and University of Missouri collaborators used unmanned aerial vehicles to collect early-season images of cotton fields and then developed and refined methods to quickly process the images and provide emergence results. The method identified the number of plant seedlings in the field and recognized weeds and other extraneous material with an accuracy rate of more than 90 percent. The near real-time processing with the new method was much faster than traditional image processing methods and will enable cotton producers throughout the world to better manage their crops for more efficient production systems to ensure a stable supply of food (cottonseed oil), feed (cottonseed meal), and fiber.

> **ARS scientists are developing low-cost remote sensing and equipment control technologies that farmers, ranchers, and processors can use with smartphone apps to manage their daily operations while reducing labor costs and improving operating efficiencies, which enables small farms to benefit from precision agriculture technologies.**

Enhancing foodborne pathogen sampling at processing facilities. Establishments producing raw ground beef products develop sampling protocols that are used to determine if microorganism levels in products are below predetermined baseline levels and that control processes adequately protect against contamination. Sampling methods are critical since improper microbiological sampling can incorrectly indicate that processing methods are effective. ARS researchers in Clay Center, Nebraska, developed new continuous (CSD) and manual (MSD) meat sampling devices for raw beef trim, and developed and validated protocols now used in commercial processing that address common variations in sampling. Findings indicate that the various alternative applications of CSD and MSD-based trim sampling for pathogen detection are equivalent or better than previous methods and provide additional benefits in reduced labor costs, other costs, and improved worker safety.

New highly efficient apple harvesting robotic arm. Automated harvesting technology is urgently needed to address U.S. labor shortages and increasing labor costs facing the multi-billion-dollar U.S. tree fruit industry. Although research into robotic harvesting has been reported in recent years, two technical challenges—picking fruit from clusters and finding fruit obscured by leaves and branches—still need to be

To download this two-pager, please visit https://go.usa.gov/xS9ax

resolved. An ARS engineer in East Lansing, Michigan, and Michigan State University scientists developed a new robotic apple harvesting technology that couples an innovative concept of vacuum sucking and rotation with a simple and effective robot arm movement mechanism. When the new harvesting robotic arm was tested in 2020 during multiple commercial field trials, it effectively and skillfully picked fruit from clusters and from deep within the canopy where apples were obscured by leaves and branches. A patent application for this technology has been filed.

Advances in precision agriculture improve sustainability of wheat, corn, and canola cropping systems. ARS scientists are developing powerful mapping and imaging tools to fight weeds, improve planting outcomes, and fight diseases in crops. ARS researchers in Pendleton, Oregon, and Oregon State University researchers developed a way to map weeds in real time during harvest operations. The high resolution weed maps were used to help explain variation in crop yield within the field and enable direct spot spraying of weeds after harvest before they re-infest the next crop. ARS researchers in Columbia, Missouri, and University of Missouri researchers developed a method for using aerial drone images to monitor corn emergence within the first week after planting; this method can be automated to help farmers scout fields for sections that need replanting. ARS scientists in Pendleton, Oregon, developed a procedure for monitoring the timing of canola flowering from satellite or aircraft-based images that can be integrated with meteorological data to predict canola yield and disease risk. These newly developed remote sensing techniques are helping growers improve productivity and sustainability across a wide variety of national cropping systems.

Cheung, Lance. Alexander Frick, Jr. uses a smart device to review data and plans his customized seed application for the day. April 13, 2021. USDA Photo. https://flic.kr/p/2m4Ka33