Ontario Tree Fruit Innovation and Technology Roadmap

Robotic Harvesting

Evaluating New Technologies

	Feasibility and cost	Implement	Labour Reduced	Changes in production	Training for staff	Impact on risk of COVID-19 Transmission
Identified Technology	low, medium, high	easy, medium, challenging	% estimate	easy, medium, hard	none, medium, high	none, low, medium, high
Robotic harvesting (using computer vision and AI)	unknown	challenging	30-50+	medium	medium	high

Current Status – In the past several years, research has focused on computer vision systems to detect, and localize apples for robotic harvesting in orchard environments. Robotics in the orchard rely heavily on the development and optimization of computer vision equipment and algorithms. Computer vision applications acquire apple tree canopy images in orchards to detect and count blooms, fruitlets, and fruit for estimating crop-load in near real-time for precision pruning, thinning, spraying, and harvesting. Many new tech companies are currently developing, piloting and optimized computer vision for crop-load estimation and management with good results so far. Innovative research is moving towards developing autonomous vehicles adapted for orchards — equipped with canopy-analyzing cameras and sensors and machine-learning computers that can geo-reference each tree. There have been new advances for robotic arms for picking fruit in the research and evaluation stage that can pick 5-10,000 apples per hour. One newly developed picker robot moves down rows of orchards and uses artificial intelligence with LIDAR (Light Detection and Ranging), a remote sensor method, to search for ripe apples of a selected size and spec. Once spotted, a robotic arm with a vacuum gently sucks the apples from the tree into a bin. Another robotic picker is a computer-guided machine with three-fingered grippers to pick apples and deposit them on a conveyor system that leads to a stem-cutting table and then a bin. Each side of the robot has six arms, arranged in pairs. There is also experimentation occurring with flying fruit picking robots (or drones) using AI to distinguish between varieties.

Feasibility of Implementing - Tall spindle tree walls or similar uniform planting structures make orchards robot ready, lending themselves more easily to the application of new precision robotic thinning technologies. The cost of implementing new technologies such as computer vision systems and robotics harvesting devices in Ontario is unknown currently. To be economical and

feasible, future development of new technologies is being driven towards more affordable solutions, such as innovative multiuse equipment and/or service model solutions. Another approach being researched, is to adopt existing vision algorithms onto a smartphone platform and mount this equipment on tractors or all-terrain vehicles. Many tech companies are also looking at offering service model packages for providing robotics solutions to growers, with pricing rates that may be more affordable for growers versus offering the equipment for purchase. A service model solution may also assist growing operations contend with repair and servicing needs, training, process implementation etc.

Impact on Labour - The development and use of robotic or automated machines in orchard operations is primarily a result of insufficient labour availability and/or rapidly increasing labour costs in tree fruit production and is critical for continued or improving yields of high-quality fruit with reduced dependence on seasonal labour. Mechanized or robotic technologies are specifically being targeted for optimizing labour-intensive work such as pruning, thinning, spraying, and harvesting. Robotic machinery further accelerates operational efficiencies because it can be functional for non-stop continuous work hours and operate both day and night. Implementing robotic machinery would shift the skill set of current on-farm labour.

COVID-19 Mitigation Risk - One of the potential benefits of robotic harvesting is to reduce labour requirements for harvesters/pickers, as such implementation of this technology would help lower the overall risk of COVID-19 exposure and transmission for growing operations.

Need for Change, Research and Training - The need for operational/process changes, research and training for growing operations would likely be substantial to implement robotic harvesting throughout the orchard. The fruiting wall should be thin and uniform for the robotic picking mechanism to reach into the canopy to harvest fruit without obstructions from overlapping branches. Many tech companies are looking at service models for offering robotic solutions with pricing rates equivalent to or below current labour costs for growers versus offering the equipment for purchase. A service model solution may also assist growing operations contend with training, process implementation, repair and servicing need etc. It is difficult to predict the level of change required until demonstration trials are complete, and the results investigated. Implementing robotic machinery would shift the skill set of current on-farm labour.