Ontario Tree Fruit Innovation and Technology Roadmap

Precision Pruning Using Computer Vision/Robotics

Evaluating New Technologies

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

Current Status – Research and evaluation trials are underway for robotic pruning equipment. 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 optimizing computer vision for crop-load estimation and management with good results so far. Innovative research is moving towards developing autonomous vehicles adapted for orchards and equipped with canopy-analyzing cameras and sensors and machine-learning computers that can geo-reference each tree. Another new approach being researched, is to adopt existing vision algorithms onto a smartphone platform and mount this equipment on tractors or all terrain vehicles.

Feasibility of Implementation –Thinner, more uniform, fruiting walls lend themselves more easily to the application of new precision robotic pruning technologies using computer vision/sensors. The cost of implementing new computer vision/sensor technology and robotics for precision pruning in Ontario is currently unknown. To be economical and feasible, future development of new technologies is being driven towards solutions such as innovative multiuse equipment and/or service model solutions. For instance, autonomous vehicles equipped with canopy-analyzing sensors and machine-learning computers that could be used all season long by changing the tool on the end of a robotic arm - a cutter for winter pruning, swaps for a string thinner at bloom and then a fruit grabber for harvest. 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 precision pruning using computer vision and robotics technology would be to help to reduce labour requirements for pruning, 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 computer vision and robotics throughout the orchard. 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 needs for example. It is difficult to predict the level of change required until demonstration trials are completed, and the results investigated.