Ontario Tree Fruit Innovation and Technology Roadmap

Precision Thinning Using Computer Vision and Robotics

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
Precision thinning (using computer vision and robotics)	unknown	challenging	50+	easy	low	high

<u>Current Status</u> - Research and evaluation trials are underway for robotic thinning 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 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. 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. Although fully autonomous orchard technologies are still under development, some mass mechanization technologies are available for non-selective blossom thinning.

<u>Feasibility of Implementing</u> – 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 in Ontario is unknown currently. To be economical and feasible, future development of new technologies is being driven towards solutions such as innovative multiuse robotics equipment and/or service model packages. 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.

<u>Impact on Labour</u> – Hand thinning fruitlets is labour intensive and expensive but is used when other methods have not removed enough fruit or more precise thinning is still required. 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 may be critical for continued fruit yields 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.

<u>COVID-19 Mitigation Risk</u> – One of the potential benefits of precision thinning using computer vision and robotics technology would be to help to reduce labour required for thinning, as such implementation of this technology would help lower the overall risk of COVID-19 exposure and transmission for growing operations.

<u>Need for Change, Research and Training</u> – 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. It is difficult to predict the level of change required until demonstration trials are complete, and the results investigated.