Ontario Tree Fruit Innovation and Technology Roadmap

Fundamental Technologies

Data Management & Orchard Infrastructure

With heightened attention being given to labour-saving robotics and other innovative tools for tree fruit growers, strategic concentration must be given to the development of:

- data management systems to track, understand and guide technological decisions (and sufficient high-speed connectivity to operate them)
- orchard planting systems that will be able to accommodate such breakthroughs

These two fundamental technologies are, in many cases, essential to implementing other new technologies.

Data Management Systems

Data Management systems are an essential tool for collecting and monitoring data to manage all aspects of fruit growing operations and a necessary piece of the puzzle when planning to incorporate new technologies and future innovations. It would be hard to know and understand how newly implemented technologies are benefiting an orchard operation without having some way of tracking data over a period of time. In many cases, new technologies feed into existing data management systems making them even more robust for growers.

Many start-up companies and long-standing industry service providers are developing promising solutions for managing data with integration strategies that bring data-driven insights to the forefront for decision-makers. Future innovative solutions are looking at bringing together real-world sensor and non-sensor data such as labour, crop protection, water and soil data, harvest data and imagery data to bring growers insights that are of value to their operations. Tech and software companies with different areas of expertise are combining forces so that different layers of data can be coordinated for greater insight. They envision a future with software platforms built on partnerships that could draw data from a dozen or so different weather, irrigation, imaging, and labour tracking apps an orchard manager might have on a phone into one centralized command centre.

Orchard Infrastructure

Vertical canopy systems were essentially developed for mechanization. Growers looking to implement platforms, autonomous sprayers, in-orchard computer vision, modernized irrigation systems, adverse weather mitigation technologies and many more upcoming innovations need to first consider and strategize orchard planting structures.

A presentation at the Wallace Presidential Lecture at the 60th Annual IFTA Annual Conference in Wenatchee, Washington by Roland Fumasi from Rabobank, sums up the changes in Tree Fruit Production below, 2017:

"*While U.S. apple-bearing acreage has declined 33% since 1997 to 2016, a yield-increase of 50% during the same period allowed the industry to produce a record crop in 2014. A significant driver of higher yields has been continued industry investment in high-density, trellis (supported) plantings on size-controlling rootstock. These modern plantings are more capital-intensive to establish, but increase long-run profitability, relative to traditional systems, due to reaching significant production earlier in the tree's life and having the potential for much higher yields. Other major apple producing countries have also implemented high-density systems, which have become more prevalent in new citrus and stone fruit plantings as well.*"

Apples

There has been an evolution in apple orchard systems worldwide. European countries developed and planted trees on size-controlling rootstocks, adopting high-density plantings well before North American growers. Size-controlling rootstocks for apple growers have been available for planting for the last 50 years in Ontario. Apple orchard systems were transformed quickly with the development of size-controlling rootstock, leading to much higher numbers of trees per acre using trellis support. Although, there are still some medium apple tree density plantings using tree stakes for supporting the tree, almost all the trees planted today are high density (900-1800 trees per acre). High-density, trellised production is shown to be more profitable compared to non-trellised orchard. According to the 2018 Cost of Establishment for Ontario Apples, high-density orchards have a greater initial investment, but the returns exceed expenses in the 5th year after planting for high-density compared to the 9th year for medium-density apple production. The most common systems in Ontario are tall and super spindle structures, but there are many types including vertical low and high trellis, V and T trellis, Ebro trellis and bi-axis.

In recent years, researchers have indicated the optimum planting density will likely remain close to 1,000 apple trees per acre. As growers become more adept at managing this density, they will likely plant slightly closer, with densities close to 1,300 trees per acre. If they adopt summer shearing to reduce cost and maintain a narrow canopy wall, they will slowly move from 12 feet between the rows to 11, 10 or even 9 feet between rows.

The planar cordon concept features multiple stems to control and distribute the canopy growth. Future systems likely will continue to utilize highly branched trees for high early yields.
"Planar canopy for automation is really the future." Dr. Stefano Musacchi (IFTA Conference 2021).

Pears

There are still many older, standard pear orchards that are trained to an Open centre style. New pear plantings use a size controlling rootstock Old Home x Farmingdale (OH x F) 87 and 97, which reduces the tree size to 80-90% of standard size. The Tall Spindle training system that is used in Ontario apple orchards is the most common high-density training system for pears, and there are some using the bi-axis system. In Oregon, some growers have used a V system of tree training to optimize light and increase fruit production. The tree height is reduced but the fruit canopy is increased. Keeping the production area close to the ground reduces the use of ladders or harvesting aids.

Peaches and Nectarines

These trees are the most challenging to train to high-density trained systems. The botanical differences between Pome fruit (apples and pears) and Drupe fruit or "stone fruit" (fruit with one pit such as peaches, nectarines, apricots, plums, and cherries) are subtle. Peaches and nectarines are the only tree fruits that do not develop spurs to produce a crop compared to other tree fruits. The trees need space and light for good growth to produce a crop for the following year.

Currently, there is not a suitable size-controlling rootstock for peaches. Research to introduce new and innovative rootstocks for these commodities is ongoing. Krymsk® rootstocks have been introduced recently, but it is too early to determine their commercial value for fruit size and vigour.

Central leader training introduced 20 years ago represents approximately 20-30% of production compared to the open centre system. The advantage of central leader training is that most of the fruit can be picked from the ground reducing the use of ladders and therefore also reducing labour. The tall spindle method for peaches of training with trellises has had some success. This would be the preferred method to move towards since it would permit future mechanization reducing labour and increasing profitability.

Tart Cherries

These trees are trained to a modified open centre system using minimal pruning. Tart cherries are the only tender fruit crop that has been successfully machine harvested for years. Three processors make up most of the remaining acreage to maximize the efficiencies of an integrated processor/growing structure.

Plums & Apricots

These trees are trained to an open centre system.

To change and mechanize to reduce labour, orchard systems must also change and become more uniform. In many cases, it is not financially feasible to change an entire orchard infrastructure midway through its life. Once growers choose the tree densities and rootstocks, they are committed to that orchard system for the next 10-25 years, depending upon the crop. Revitalization of orchards can progress much faster with the proper support and a clear vision for change.