BC FoodWeb

Based on a Government Publication

Rootstock selection for Honeycrisp apples

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KEY TAKEAWAYS

- M9 rootstocks have historically been the most common rootstock for Honeycrisp production in BC. They have allowed growers to plant at high densities, resulting in higher yield per land area. However, they also have some **disadvantages which have become more apparent with climate change**, such as cold damage and high pest susceptibility.
- This study identified other **dwarfing and semi-dwarfing rootstocks** (such as G.4004, G.41N, and G.11) with disease resistance and extreme temperature tolerance that can produce similar or higher yield than M9.

How can this research be used?

Growers can use the information presented in this brief to select the most suitable rootstock based on their unique needs and growing conditions. It is advised that choosing a suitable rootstock for Honeycrisp take climate resilience into consideration (for example, a rootstock with good cold hardiness) and avoid rootstocks that lead to excessive root suckers and severe chlorosis.

Why was this research done?

Since its release in 1991, Honeycrisp has become one of the most sought-after apple varieties. Its juiciness, firmness, crispiness, and well-balanced sweetness and tartness make it desirable to consumers. However, growers have had to manage undesirable pre- and post-harvest traits of Honeycrisp, such as severe leaf chlorosis and strong biennial bearing.

(*Continued on next page)*

Production Type
- Tree fruit

Practice Benefit(s)
- Improved yield
- Improved cold hardiness
- Improved disease resistance

Research Location
- Summerland, BC

Key Terms
- *Chlorosis*: The yellowing of leaves due to nutrient deficiencies, poor soil conditions, or environmental stress.
- *Cumulative yield*: Total yield for a single tree over X number of years.
- *Trunk cross section area (TSCA)*: The area of the circle that results when a tree is cut.
- *Yield efficiency*: How much fruit production the tree supports per unit area of the trunk cross section.
- *Estimated yield*: hypothetical fruit yield based on yield per tree and planting density.

Currently, M9 rootstocks are heavily used in BC's apple production. M9 was the first commercialized dwarfing rootstock that helped growers plant in high density, resulting in improved yield per land area. However, it also has a few disadvantages, including low tolerance to extreme temperatures and poor resistance to some common pests, which has become more apparent with climate change.

The goal of this research was to identify more sustainable (economically and environmentally) alternative rootstocks to M9 for honeycrisp. Selecting the right rootstock to start with can help growers manage these issues, saving them time and money on orchard management. **Researchers tested the performance of Honeycrisp on 16 rootstocks against M.9T337**. The experiment included 2 industrial standard Malling rootstocks, 4 Budagovsky rootstocks, and 9 Geneva rootstocks.

What was the outcome?

Here are some highlights of the 16 rootstocks evaluated, including recommendations for their use:

Semi-dwarfing

- **G.4004** led to high cumulative yield and did not show any undesirable traits.

Large and moderate dwarfing

- **G.41N** led to higher cumulative yield than the standard M.9T337 and did not show undesirable traits. G.41N may be susceptible to brittle graft union, so it is advised to use a bamboo support system.
- **G.935N** and **G.4814** performed well in vigour and fruit production (had high cumulative yield efficiency), making them good alternatives to M.9T337. However, because these rootstocks produce more root suckers and have more drastic biennial bearing, good crop load and root sucker management are needed.
- **G.11** demonstrated similar vigour and cumulative yield to M.9T337. It had better resistance to fire blight and replanting disease than M.9.
- **Based on our research, we would not recommend G.214 for Honeycrisp**. It had the highest cumulative yield efficiency, but it also had small TCSA (produced very small trees), a lot of root suckers, and severe leaf chlorosis. These factors indicate that the rootstock did not effectively transport nutrients throughout the tree.

Small dwarfing

- **G.4003 and B.9** were less vigorous and less productive than M.9T337. To match or exceed the yield per hectare of M.9T337, small dwarfing rootstocks would need to be planted at narrower in-row tree spacing.

The full performance of all 16 rootstocks, including fruit production, tree vigour, disease resistance, and environmental tolerance, is outlined in Table 1 and Figure 2.

Figure 1. Graft union of semi-dwarfing (G.4004), large dwarfing (G.41N), and small dwarfing (B9) rootstocks. Photos by H. Xu, AAFC.

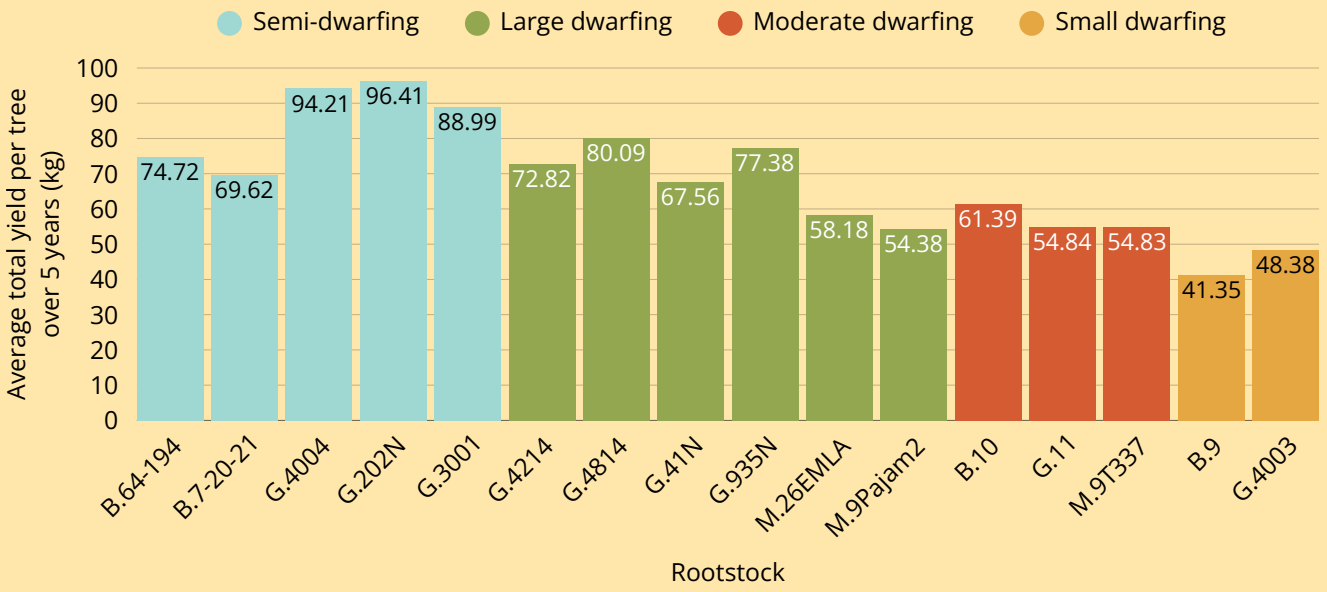

Figure 2. This figure shows the average total yield per tree (cumulative yield) over 5 years (2014-2018); Honeycrisp apple on 16 rootstocks.

What's next?

Ongoing research is exploring how rootstocks shape the health and yield of apple varieties, including Ambrosia and Buckeye Gala. In one study, scientists evaluated how rootstock choice influences water transport and stress tolerance in apple trees. These efforts are vital for developing strategies that help producers sustain apple yields in a changing climate.

How was the research done?

The planting was established in 2010 at the Summerland Research and Development Centre (Agriculture and Agri-Food Canada). The trees were trained to tall spindle axes and spaced at 4 x 12 ft apart (1.2 x 3.7 m), with trunks supported by both bamboo and 4-wire vertical trellis system. Winter pruning was usually conducted in February to March. Crop load was managed by chemical blossom thinning, and chemical and hand thinning on fruitlets. Water and nutrients were supplied through drip irrigation and fertigation. Overhead irrigation was applied in July and August to provide canopy cooling. In this study, commonly observed horticultural challenges included excessive root suckers, leaf chlorosis, biennial bearing, large variations in fruit size, and high incidence of bitter pit and soft scald after air storage.

We collected data on TCSA, yield, tree height, tree canopy width, number of root suckers, and chlorosis during 2010-2018.

Figure 3. Field overview of Honeycrisp rootstock trial in April 2021 in Summerland, BC. Photo by H. Xu, AAFC.

About this brief

This brief was prepared by Juliana Cao and Nisa Chavez from the BC Food Web team, with the help of Hao Xu, and is based on the following Government of Canada publication:

- Xu, H., MacDonald, JL., Singh, A., Pagliocchini, C., & Ediger, D. (2022). Apple rootstock vigor and production: effects of rootstock on Honeycrisp. Agriculture and Agri-Food Canada, Summerland, BC, Canada. 11p. https://publications.gc.ca/site/eng/9.910864/publication.html

Want to learn more?

- For any questions regarding this research, contact Hao Xu at hao.xu@agr.gc.ca.

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Funding for this research was provided by Agriculture and Agri-Food Canada. This research was conducted by Agriculture and Agri-Food Canada (Summerland, BC) in collaboration with NC140 Rootstock Research Committee.

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

NC-140

Funding for this research brief is provided by the Government of British Columbia through programs and initiatives delivered by the Investment Agriculture Foundation of BC.

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