Cold Hardy Rootstocks for Eastern New York

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Cold injury is a concern for apple production in Eastern New York, where extremely cold mid-winter temperatures and dramatic temperature fluctuations in the late fall and early spring are not uncommon. Let's review the types of cold damage we might expect to see in rootstock tissues, and discuss which rootstocks might be most appropriate for dealing with the cold in a high density production system.

Cold injury occurs when water in the living cells of the vascular system freeze. Ice crystals in the cells rupture the cell membranes, leading to death of the vascular tissue (Schupp et al., 2001). This injury will generally occur in one of two regions within the rootstock; in the trunk, or in the roots. Trunk injury commonly occurs just above the soil line between late October and December, when temperatures fluctuate between stretches of relative warmth and the occasional blast of cold. The lower trunks are sensitive because cold acclimation begins in the growing tips of the trees, leaving the trunk to be the last above ground portion to acclimate. The trunks are also susceptible as trees deacclimate early in the spring (Moran et al, 2018).

In addition to trunk damage in late fall and early spring, trunks and roots are also vulnerable to cold injury in the middle of the winter, when temperatures in the orchard hit their minimum. Roots do not acclimate to the cold as fully as the trunks do, and can be injured at higher temperatures. This does not occur that often, as soil temperatures at the root zone are generally warmer than the air temperatures. Damage to the roots is usually observed in very cold years when there has been poor snow cover, as adequate snow cover insulates the roots from the cold (Moran et al, 2011).

So, with this information in mind, how tolerant are our current rootstocks to the cold? It is difficult to determine hard cutoff temperatures for where cell death might occur, as cold hardiness is dependent on many conditions surrounding the cold event, including the weather before and after the event, the orchard management practices used in the block, and the health of the trees. We can, however, compare rootstock hardiness relative to one another, placing rootstocks into loose categories ranging from more to less cold hardy.

M.26 is well-known for being the most cold-hardy of the Malling dwarfing rootstocks (Quamme, 1990). However, the vigor of M.26, along with the rootstock's susceptibility to fire blight and its propensity for developing burr knots, presents other horticultural challenges that can limit its further planting in high density systems.

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M.9 and its various clones remain some of the most widely planted dwarfing rootstocks. M.9 has shown good hardiness in late fall and early spring, but its roots are relatively tender, and is more susceptible to mid-winter cold injury, particularly in years where snow cover might not be adequate.

Bud. 9 has been found to be as cold hardy as M.26 (Moran et al, 2011). However, Bud. 9 deacclimated more quickly than M.9 and M.26 when exposed to ten days of above freezing temperatures in mid-January in a lab study. This may make it more susceptible to freeze events in years where temperatures fluctuate (Forsline, 1983).

The Cornell Geneva rootstocks were bred for resistance to fire blight, phytophthora crown and root rot, and for tolerance to wooly apple aphid and apple replant disease. They were also bred with cold hardiness in mind, and have been studied in recent lab hardiness tests.

The Honeycrisp rootstock trial in Peru contains Malling rootstocks to serve as commercial standards, as well as many of the cold hardy Geneva rootstocks.

G.41 is a becoming a popular rootstock, and lab studies have found that root winter hardiness may be comparable to M.26. However, these results were not always consistent, and hardiness was dependent on how extensive the root system of G.41 was prior to the cold event. When compared to M.9 in lab studies of spring freeze events, G.41 may be slightly more susceptible to spring freezing due to slightly earlier deacclimation.

G.935 is becoming more popular, and is useful for weak growing scion varieties. A lab study has found the roots of G.935 to be more cold-hardy than M.26, and trunk tissues of G.935 were hardier than M.26 above the soil line in October, suggesting G.935 may be very well suited for production in areas where extreme cold hardiness is a requirement (Moran et al., 2011).

G.11 roots have also been rated with similar cold hardiness as M.26. It appears to have similar early winter cold hardiness to M.26 as well.

While these lab studies have been performed, further testing is warranted to understand how trees might respond under different cold injury scenarios. Outside of the lab, many rootstocks have been evaluated in field trial plantings. During a mid-winter freeze in the winter of 2004 in the Champlain Valley, many trees on M.26 and M.9Nic29 rootstocks died of cold injury, while G.16 and G.30 had very good rates of survival (Robinson et al., 2006). Unfortunately, these were the only two Geneva rootstocks in the trial at the time, and since then a test winter has not been observed. While Geneva rootstocks have the potential to deacclimate somewhat earlier than some Malling rootstocks, very few trees have been lost in years where there has been an early warm spell (Robinson, 2018).

Other new Geneva rootstocks are being evaluated for cold hardiness, but have not yet been released for commercial production. Many promising new cultivars from the Geneva and other rootstock breeding programs are being evaluated in replicated trials across the country. Some are also in field trials in Peru and Highland, so stay tuned for future reports on their performance in our Eastern New York conditions.

While cold hardiness is an important factor for rootstock selection, there are countless other variables to also consider. Some of these include: disease resistance, productivity, and precocity. While there may never be a perfect rootstock, you can choose the best rootstock to fit your orchard blocks' unique set of challenges.

Citations:

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