Apple Rootstock Trial

At the Western Agricultural Research Center
Corvallis, MT

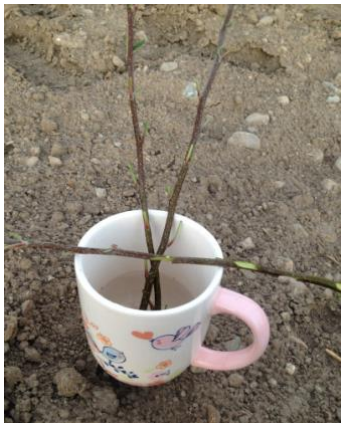
Project Background

We are conducting this trial in order to provide local data for Montana commercial dessert and cider apple growers as well as homeowners. Our research team is testing six different apple rootstock cultivars, described in the table below. We chose cultivars that would contrast a range of tree sizes and disease tolerances and compare industry standards with the newer 'Geneva' series. We specifically included 'M26' as some growers have found it to be very cold tolerant; however, growers in other locales tend to avoid it due to its extreme susceptibility to root diseases. To our knowledge, cold tolerance in 'M26' has not been field tested. Also note that after planting the trees for this rootstock trial, we learned of another cold tolerant rootstock—'Antonovka.' Its fruit happens to be suitable for fresh eating. However, the rootstock is vigorous and grows a full-size tree.

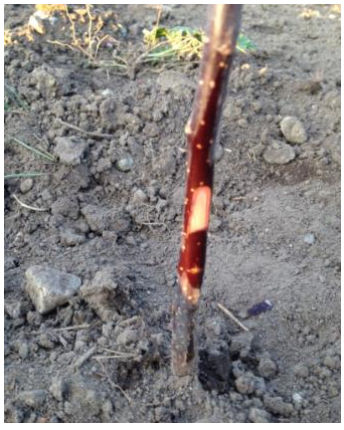
We used 'EverCrisp' as the scion for grafting onto the rootstock using the bud grafting technique shown below. 'EverCrisp' is a new variety from the Midwest Apple Improvement Association, with 'Honeycrisp' and 'Fuji' parentage. It is supposed to store well, staying firm and tasting great for months after harvest. We will test its viability in Montana, documenting its precocity (how old the trees are when they can support a crop) on the rootstocks in our trial, as well as yield, storability, fire blight incidence, bitter pit incidence, bloom and ripening dates, and other horticultural characteristics.

Our trial is set up as a randomized complete block design with 11 blocks and 1 tree of each rootstock cultivar per block (see the rootstock trial map). The 12th block was left un-grafted intentionally. We want to see how large the rootstocks grow on their own and are curious to see if the fruit of the rootstocks is useful for cider making, especially for the varieties with disease and cold tolerance.

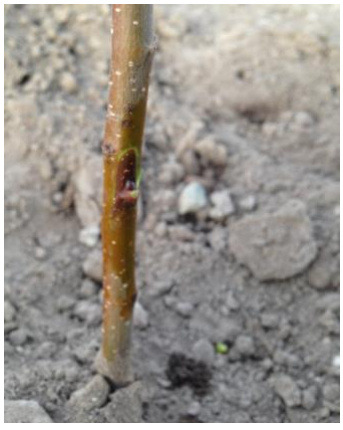
Steps in Bud Grafting



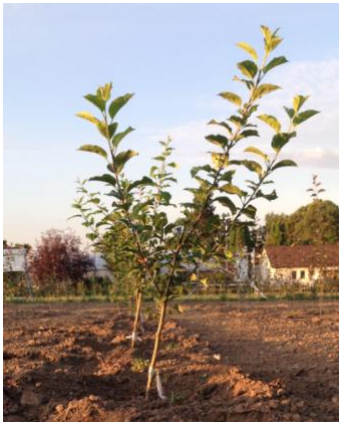
1. Scions with budwood cut out for grafting



2. A notch has been cut in the rootstock stem to prepare it for bud grafting



3. Scion budwood is set into the notch



4. The graft union is wrapped in plastic to seal in moisture

Table 1. Apple Rootstocks in WARC Trial

Rootstock	Budagovsky 118	Geneva 890	Geneva 935	Malling 7 EMLA	Malling 9 selection NIC 29	Malling 26 EMLA
Synonyms	Bud.118, B.118	G.890	G.935	M.7 EMLA	Nic 29®, M.9 Nic 29	M.26 EMLA, EMLA 26
Tree size	Semi-dwarf [1,2]	Semi-dwarf [1,3]	Dwarf [1] Semi-dwarf [6,10]	Semi-dwarf [3,5]	Semi-dwarf [1] Dwarf [3,6]	Dwarf [8,9]
Productivity	Moderate [2] Decreases annually [7]	Higher than M.7 [1] Good [8]	Good [2]	Not impressive [5]	Good [1]	
Precocity	Early [2]	Intermediate [1]	Early [1,2]		Very early [1]	Very early [1]
Winder hardiness	Very hardy [1,2,3,7,8,9]	Hardy [3,7]	Hardy [1] Very hardy [8]	Low [5] Moderate [1,7]	Hardy [1] Low [7]	
Tree support needed	No [1,2,9]	No [1,3,8]	Yes [1,2]	Yes, staking for trunk support first 4-5 years [4] No, when planted in deep, well-drained soils [3]	Yes [1]	Yes [8]
Fire blight resistance	Moderate [1,2,3,7] Low [6]	High [1,3,7,8]	High [1,2,3,6,7,8,9]	High [6] Low [7]	None [1,3,7]	Low [4,8,9]
Crown/rot resistance	Moderate [1,2,7]	High [1,3,7,8]	High [1,2,3,6,7,8]	Moderate [6,7]	Moderate [1] High [7]	Moderate [1,2]
Replant disease resistance	Low [7]	High [7,8]	High [7,8,9]	Moderate [7]	Low [7]	
Woolly aphid resistance	None [7]	High [1,3,7,8]	None [1,3,7,8,9]	None [7]	None [1,7]	None [9]
Suckering	None [3]		Moderate [1,2] Low [9]	High [1,3,4,5,7]	Moderate [1]	Low [4]
Burrknots				Yes [6]		Yes [4,8]
Other notes	Resistant to apple scab [8] Adaptable to various soil types (as long as well-drained); some bitter pit in WA [7]	Bitter pit a concern; good replacement tree in difficult soils [7]	Well-adapted to most soils [2] Good rootstock for weaker scion varieties [7]	Protect from wind; bud high and plant deeply in good soils [5]	Works well with slow-growing scions [7]	Trees should be planted with graft a few inches aboveground [4,8]

Sources for Table 1 data

1. USDA Cooperative Extension
2. Washington State University
3. PennState Extension
4. University of New Hampshire Extension
5. Ontario - Ministry of Agriculture, Food and Rural Affairs
6. University of Missouri - Integrated Pest Management
7. Good Fruit Grower
8. TRECO® - Oregon Rootstock & Tree Company
9. Adams County Nursery - 2017-2018 Fruit Tree Catalog
10. HortScience - Volume 40: Issue 4

Results through 3/24/2021

In spring 2021, rootstocks will be entering their second year at WARC following planting in spring 2019. We summarize information on tree survival, tree size, and cold injury below.

Brief timeline

- 04/26/2019 - rootstocks planted
- 08/06/19 - 08/08/19 'EverCrisp' grafted to rootstocks
- spring 2020 - graft and rootstock survival documented (data not shown)
- fall 2020 - 'EverCrisp' re-grafted to rootstocks where grafts failed; two buds this time
- 09/20/20 - survival and diameter documented
- 10/25-26, 2020 - temperatures reach minimum -5 F, following a mild fall
- 03/23/2021 - cold injury documented

Tree or rootstock survival

Table 2. Tree or rootstock survival as of 09/20/20 (includes grafted rootstocks and rootstocks where grafts failed). Statistics indicate a significantly lower survival rate of 'G935'; however, some of these met their end by tractor.

Cultivar	Number alive out of number planted	Percent survival[1]	
'M9Nic29'	12 of 12	100 %	a
'Bud118'	11 of 12	92%	ab
'EMLA 26'	11 of 12	92%	ab
'M7'	11 of 12	91%	ab
'G890'	8 of 12	66%	ab
'G935'	5 of 12	58%	b

[1] Pearson's exact chi-square: $X^2 = 12$, df = 5, p = 0.0393 (significant). Cultivar comparisons established by pairwise Pearson's chi-square tests with $p < 0.05$.

Tree size

Table 3. Trunk diameter 3 inches above the graft union, where the graft was successful

Cultivar	Trunk diameter (in)[1]	
'G890'	15.3	a
'Bud118'	13.7	ab
'G935'	11.8	bc
'M7'	10.7	c
'M9Nic29'	10.6	c
'EMLA 26'	10.5	c

[1] ANOVA type III sums of square (cultivar), 12.65, p-value, <0.001; Tukey-Kramer post-hoc means separation. Means followed by different letter are statistically different.

Cold injury

We had a mild fall in 2020, with only several light frosts prior to temperatures dropping suddenly to lows of -5 F on October 25 and 26. On in spring 2021 (03/23/21), we recorded the presence of cold injury (yes or no) (branch dieback, sunken bark), on either the scion or the rootstock, which we attribute to this sudden cold. Cold injury was more obvious and severe on ungrafted rootstocks than the scion. In addition to extreme cold midwinter in parts of Montana, sudden temperature drops in late spring or early fall are not uncommon: resilience to these conditions could be an important cultivar characteristic.

Table 4. Cold injury apparent on either scion or rootstock, 03/23/21.

Cultivar	Cold injury 03/23/21 (note some trees had died prior to cold temps)	Percent with cold injury[1]
'M9Nic29'	5 of 12	42%
'Bud118'	0 of 11	0%
'EMLA 26'	3 of 11	27%
'M7'	4 of 11	33%
'G890'	1 of 8	13%
'G935'	2 of 5	40%

[1] Pearson's exact chi-square: $X^2 = 7.31$, df = 5, p = 0.2075 (not significant).

Some Grafting Terminology

Grafting

Apple growers use grafted trees in order to produce a uniform crop that will perform well for their market goals and for the local site conditions. Grafting involves fusing the stem of one species or cultivar of tree or vine with a different, compatible type to create a plant with desirable characteristics of both types.

Rootstock

The rootstock composes the lower part of a grafted tree—including the root system and basal part of the stem. Fruit growers choose rootstock cultivars for their ability to impart characteristics such as pest and disease resistance, environmental stress tolerance, higher productivity, and/or tree size.

Scion

The upper portion of a grafted tree arises from the scion. Scions are pieces of stem containing buds or shoots collected from a differing cultivar and grafted onto the rootstock. The scion cultivar is selected mainly for the qualities of its fruit.