

# Apple Rootstocks

**Penn State participates in multi-state apple rootstock trials, such as those organized through the NC-140 rootstock project. The following rootstock descriptions and comments are based on results from these trials.**



Trees trained to a tall spindle system are commonly grown on M.9 rootstock, although new rootstocks are on the horizon.

**Rootstocks, Listed in Order from Smallest to Largest**

## **Malling 27 (M.27)**

A very dwarfing rootstock. Unless the central leader is supported, the tree will be very small. Little is known about disease or insect susceptibility. To date, most commercial nurseries are using this rootstock only as an intermediate stem piece on MM.106 or MM.111. If handled and spaced properly, it can be a very productive stock for a vertical axe system.

## **Geneva 65 (G.65)**

Geneva 65 (G.65) was developed by Dr. Jim Cummins at Cornell University. Due to errors in tissue culture buildup of this rootstock, the U.S. distribution of this rootstock has been hindered. Tree size once thought to be about that of M.9 is now considered to be closer to M.27. The rootstock is difficult to propagate in nursery stool beds. It is susceptible to tomato ring spot virus and apple stem grooving virus.

## **Budagovsky 9 (B.9 or Bud9)**

Budagovsky 9 (B.9 or Bud9) is a new dwarfing rootstock bred in the Soviet Union from the cross of M.8 x Red Standard (Krasnij Standart). Like the other stocks in this series, the leaves are a distinctive red. Trees on this stock are 25 to 35 percent smaller than M.9EMLA depending on the cultivar. In a 10-year trial at University Park, York Imperial, Rome Beauty, and Empire on B.9 were approximately 25 percent smaller than the same cultivar on M.9EMLA; while Jonagold, Golden Delicious, and McIntosh were approximately 35 percent smaller. B.9 appears to be resistant to collar rot and is very cold-hardy. In limited trials, it has performed very well across a wide range of conditions. Trees will need to be supported.



## Malling 9 (M.9)

The traditional and best-known dwarfing rootstock. It should be planted on a well-drained site. Trees on this rootstock always require leader support. The rootstock is very susceptible to fire blight and can develop burr knots. Numerous clones of M.9 are now being sold by nurseries, including M.9 NAKB 337, the current dominant strain used. It is a virus-free clone from the Netherlands and appears to be 5–10 percent less vigorous than M.9EMLA. M.9EMLA is a virus-free clone from the East Malling/Long Ashton research stations. It is approximately 25–30 percent more vigorous than M.9. Pajam 1 (Lancep) and Pajam 2 (Cepiland) are French selections that are relatively new. They are 35 to 40 percent more vigorous than M.9 NAKB 337. One other clone is M.9 RN 29, selected by Rene Nicolai in Belgium. In plantings at University Park with Gala, it is approximately 30 percent larger than M.9 NAKB 337.

## MARK

Formerly named MAC 9, developed in Michigan. It is an open-pollinated seedling of M.9. Trials in Pennsylvania indicate that this rootstock is not freestanding and is slightly larger than M.9. The central leader tends to lean. In recent years this rootstock has fallen into disfavor due to an abnormal growth proliferation at the soil line. Trees with this growth proliferation cease to grow and become spur bound; therefore, it is not recommended to be planted unless supplemental irrigation is provided. Very drought sensitive.

## Geneva 16 (G.16)

Geneva 16 (G.16) was released from Cornell University's breeding program. Like others in the series, it is resistant to fire blight. It is tolerant of collar rot and immune to apple scab. It is susceptible to woolly apple aphid and powdery mildew. Size is reported to be between that of M.9 and M.26. In a trial at Rock Springs at the end of the fourth growing season it is approximately 14 percent larger than M.9T337 and 8 percent smaller than M.26. It does appear, however, to induce wider branch angles in the scion cultivar. Geneva 16 is very sensitive to latent viruses in apple and should only be propagated with virus free scion wood on top.

## Geneva 41 (G.41)

Geneva 41 resulted from a cross between M.27 and Robusta 5 and was introduced by the New York State Agricultural Experiment Station, Geneva, New York. Geneva 41 has been tested as CG 3041 and is a full dwarf, similar in size to M.9 NAKBT337. It is highly resistant to fire blight and *Phytophthora*, and in initial tests it appears to be tolerant of replant disease. It is being tested in the 2003 NC-140 trial at 12 locations with Golden Delicious as the scion cultivar. After five years, it produces trees similar in size to M.9, but it has higher yield efficiency and produces few root suckers.

## Budagovsky 10 (Bud 10 or B.10)

Budagovsky 10 is a release from the Michurinsk University of Agriculture (Russia) breeding program, which is trying to select for improved winter hardiness. A 10-year trial in Pennsylvania with Golden Delicious as the scion cultivar showed that trees on this rootstock were similar in size to trees on G.935 and M.9 T337 (15 percent smaller). Main scaffold branch angle was close to 90 degrees. Production efficiency and total yield were slightly better than trees on M.9 T337. The rootstock is recommended for trials.

## Ottawa 3 (O.3)

This rootstock was bred in Canada for its cold hardiness, with one parent being M.9. Trees on O.3 are about the size of M.9EMLA but smaller than M.26. Induces early bearing. Resistant to collar rot, but susceptible to fire blight and woolly apple aphids. Ottawa 3, although being available for many years, has not been popular with the nursery industry. Young stool beds of O.3 produce few saleable liners, although with age the stool beds become more productive. Ottawa 3 is very susceptible to apple mosaic virus, so only material known to be virus free should be planted on this rootstock.

## Vineland 1 (V.1)

This rootstock came from the breeding program at the Vineland station in Ontario, Canada. Tree size is comparable or slightly larger than M.26. Yield efficiency and fruit size are equal to or greater than M.26. However, unlike M.26, it appears to be highly resistant to fire blight.

## Malling 26 (M.26)

A more vigorous rootstock than M.9. It can be used to produce either a dwarf or a semidwarf tree, depending on scion variety, production system, and soil type. It is susceptible to collar rot and fire blight and should not be planted in a wet site. Certain varieties, such as Rome, Stayman, Golden Delicious, and many triploids, when grafted onto this rootstock may exhibit signs of graft union incompatibility. When incompatibility occurs, the trees may break off at the union in high winds. Because exposed portions of the rootstock have a strong tendency to produce burr knots, the union between the scion variety and the rootstock should be set no more than 1 to 2 inches above the final soil level.

## Geneva 214 (G.214)

Geneva 214 (G.214) is a cross of Robusta 5 x Ottawa 3 and tested as CG.4214. Trees on this rootstock will need to be supported and produce a tree about 30-35% size of seedling with vigor and precocity similar to M.9 Nic.29 and M.26. Trees are more productive than those rootstocks and have good cold hardiness, and are resistant to fire blight, *Phytophthora* root rot and woolly apple aphid.

## Geneva 935 (G.935)

Geneva 935 (G.935) is a 1976 cross of Ottawa 3 and Robusta 5. Size is reported to be slightly larger than M.26, but the rootstock has resistance to fire blight and crown rot. It is not resistant to woolly apple aphid. Production efficiency is rated equal to M.9. In the Golden Delicious trial at Rock Springs in 2006, tree size was about 9 percent larger than M.9 and 12 percent smaller than M.26. Production efficiency was not significantly different although slightly higher than M.9 in 2005. The rootstock seems to induce wider angled branching in the scion.

## Geneva 11 (G.11)

The second release of the Cornell breeding program; only limited plantings exist in Pennsylvania. Reported to be similar in size to M.26 but more productive. Has the advantage of being resistant to fire blight and crown rot as well as only rarely producing suckers or burr knots. Availability limited. Tissue-cultured trees are larger than trees propagated by stool beds.

## Geneva 202 (G.202)

Geneva 202 (G.202) is a semidwarfing rootstock that produces a tree slightly larger than M.26. It was developed from a cross of M.27 and Robusta 5. It is fire blight and phytophthora resistant as well as having resistance to woolly apple aphids. The rootstock has been mainly tested in New York and New Zealand. In New Zealand they are looking at this rootstock as a possible replacement for M.26 since it is more productive than M.26. In a 9-year study with the scion cultivar of Liberty, G.202 was about 50 percent smaller than M.7 but had much greater production efficiency.

## Geneva 210 (G.210)

Geneva 210 (G.210) is a semidwarfing rootstock that is resistant to fire blight (*Erwinia amylovora*) and crown rot (*Phytophthora* spp.). It is a hybrid from a cross between Ottawa 3 and Robusta 5, and is larger than Ottawa 3 but smaller than Robusta 5. It is similar in size to Malling 7 but more productive and precocious.

## Geneva 890 (G.890)

Geneva 890 (G.890) is a semidwarfing rootstock about 50-60% size of seedling that is resistant to fire blight (*Erwinia amylovora*), crown rot (*Phytophthora* spp.) and woolly apple aphid with good cold hardiness. At this time production of root suckers and burr knots is unknown. Tree size is approximately the same as M.7 to MM.106 but with yield efficiency similar to M.9. higher and earlier production. Rootstock was released for use as a free standing tree for processing orchards or with a weak scion cultivars.

## Geneva 969 (G.969)

Geneva 969 (G.969) is a semidwarfing rootstock that is resistant to fire blight, crown rot, and woolly apple aphid with good cold hardiness. It is classified as having growth control similar to M.7 at about 45-55% of seedling. The rootstocks produce few root suckers or burr knots. Suggested for trial for growers desiring a freestanding tree.

## Pillnitzer Supporter 4 (Pi.80)

Pillnitzer Supporter 4 (Pi.80), a cross between M.9 and M.4, has recently been introduced from Germany. It is reported similar in size and in anchorage to M.26. Yield capacity is reported to be better than that of M.26. A planting with McIntosh as the cultivar was established at Rock Springs. Supporter 4 grew to about 15 percent larger than M.7 EMLA. Yield was nearly double that of McIntosh/M.7EMLA and 50 percent greater than McIntosh/M.26EMLA.

## Interstems

This stock is composed of an understock such as seedling MM.111 or MM.106, onto which an intermediate stem piece of M.9 or M.27 is grafted. The variety is budded or grafted onto M.9 or M.27. Size control is directly related to the length of the intermediate stem piece. Interstem apple trees offer a strong root system while reducing the size of the overall tree. Interstem trees should be planted so that a portion of the interstem is buried. Test plantings in Pennsylvania indicate that interstems on either MM.106 or MM.111 sucker, and very vigorous varieties like Stayman have not performed well on interstems.

## Geneva 30 (G.30)

The advantages of this M.7-size rootstock are early production, fewer burr knots, and less suckering. Tests at Rock Springs do indicate that trees on this rootstock come into bearing earlier and produce more fruit than M.7. Unfortunately, questions have arisen about the graft compatibility of this rootstock with Gala. In tests around the country in the NC-140 trials, there have been occasions where Gala/G.30 have snapped off at the bud union during high winds. Therefore, it is recommended that if Gala is propagated on G.30, the trees be supported by two wires, one at approximately 36-40 inches above the ground and a second wire at 8-9 feet. Individual stakes or poles have not been sufficient because they allow excessive twisting of the trees in the wind.

## Geneva 222 (G.222)

This rootstock was developed from a cross of Robusta 5 x Malling 27. The semidwarfing rootstock is approximately 45-55% the size of seedling and needs to be supported. Trees on this rootstock are similar in vigor to M.7 but more precocious and productive with good cold hardiness; resistance to fire blight, *Phytophthora* root rot and woolly apple aphid.

## Malling 7 (M.7)

This rootstock produces a semidwarf tree that is freestanding in deep well drained soils. In rocky, steep, or shallow soils, it tends to lean. High budding and deeper planting will help remedy this problem. The rootstock may sucker profusely and is susceptible to collar rot. M.7a is a clone of the original M.7 that has had some of the inherent viruses removed.

## Malling-Merton 106 (MM.106)

A rootstock, slightly larger than M.7, that produces freestanding, early bearing trees. Trees on MM.106 are susceptible to collar rot when planted in wet soils and are not recommended for poorly drained sites. Delicious on MM.106 is susceptible to apple union necrosis.

## Malling 2 (M.2)

An older rootstock that is reappearing in nurseries and orchards. It produces a semidwarf to semistandard freestanding tree, depending on scion variety. Trees are strong, crop well, and do not have collar rot problems.

## Poland 18 (P.18)

This stock holds the most promise for those wanting a larger tree about the size of MM.111. Its other advantages are tolerance to fire blight and resistance to collar rot. It will probably perform better in wet or heavier soils.

## Malling-Merton 111 (MM.111)

A well-anchored rootstock, resistant to woolly apple aphids, and tolerant of drier soil conditions. It is the most cold-hardy rootstock readily available. Trees on MM.111 are semistandard to standard in size. Planting depth of this rootstock is critical. The union should be no higher than 1 to 2 inches above the final soil line.

## Budagovsky 118 (B.118)

Budagovsky 118 (B.118) is a more vigorous clone out of the Minsk breeding program. It is more vigorous than the other rootstocks in the series but still imparts the high degree of winter-hardiness. It propagates easily in stool beds and does not sucker. It has moderate resistance to fire blight but is susceptible to *Phytophthora*. Because of the vigor of the rootstock it is only recommended for spur strains of apple or in weak soil or replant situations.

## Seedling

A rootstock from apple seeds, with a variable genetic makeup and suckering and disease susceptibility. Varieties on this rootstock produce the largest trees. Few nurseries that supply commercial fruit growers have trees grafted onto seedling for sale anymore.

Source: Penn State [Tree Fruit Production Guide](#) (Updated December 2015).

## Contact Information

### Robert Crassweller

Professor of Tree Fruit  
[rnc7@psu.edu](mailto:rnc7@psu.edu)  
814-863-6163

### James Schupp

Professor of Pomology  
[jrs42@psu.edu](mailto:jrs42@psu.edu)  
717-677-6116

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