Performance of Trees in the Massachusetts Planting of the 1994 NC-140 Apple Rootstock Trial over Seven Growing Seasons

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Over the last several years, the cost of producing apples has continued to increase, while returns have remained the same or increased only modestly. To remain profitable, apple growers must search out and adopt any efficiencies possible. One such efficiency is the use of dwarfing rootstocks. Fully dwarf rootstocks result in trees ranging from 10% to 40% of a standard, seedling-rooted tree. Compared to standard or semidwarf trees, these smaller trees produce similar or greater yields per acre, generally have larger fruit size and better color, require less pruning and harvest labor, and greatly reduce the amount of pesticides required to treat an acre. On the other hand, dwarf trees must be planted at significantly higher densities than semidwarf or standard trees, therefore they cost much more per acre to establish. This increased cost must be offset by the use of the optimum rootstock and planting density for a given condition so as to reduce the risk of inefficiency. Selecting the best rootstock is not always easy, since several dwarf rootstocks are now commercially available.

To aid growers in making these decisions, the NC-140

Table 1. Trunk cross-sectional area, suckering, yield, yield efficiency, and fruit weight in 2000 of Gala trees on several rootstocks in the Massachusetts planting of the 1994 NC-140 Apple Rootstock Trial.[z]

Rootstock	Trunk cross-sectional area (cm^2)	Root sukers (no./tree, 1994-2000)	Yield per tree (kg) 2000	Yield per tree (kg) Cumulative (1996-2000)	Yield efficiency (kg/cm^2 TCA) 2000	Yield efficiency (kg/cm^2 TCA) Cumulative (1996-2000)	Fruit weight (g) 2000	Fruit weight (g) Average (1996-2000)
M.9 EMLA	35.8 def	5.6 bcd	57 ab	132 bcdef	1.66 a	3.85 abc	150 a	169 abcd
M.26 EMLA	53.8 ab	1.0 d	60 ab	151 abcd	1.13 bcde	2.94 c	151 a	165 abcde
M.27 EMLA	9.3 j	3.8 cd	13 f	35 jk	1.31 abcde	3.90 abc	147 a	140 gh
M.9 RN29	42.7 bcd	12.9 abcd	64 a	159 abc	1.45 abcd	3.68 abc	158 a	179 a
M.9 Pajam 1	40.0 cde	13.7 abcd	55 ab	135 bcdef	1.42 abcd	3.45 abc	154 a	173 abc
M.9 Pajam 2	49.5 abc	23.0 a	67 a	168 ab	1.38 abcd	3.44 abc	148 a	180 a
B.9	27.1 efgh	7.0 bcd	40 bcde	96 efghi	1.45 abcd	3.62 abc	147 a	164 abcdef
B.491	12.7 ij	3.6 cd	19 ef	53 ijk	1.55 abc	4.21 ab	148 a	151 defgh
0.3	34.0 def	17.2 abc	53 ab	144 abcde	1.55 abc	4.37 a	147 a	160 bcdef
V.1	61.8 a	10.5 abcd	51 abc	191 a	0.85 e	3.17 bc	159 a	175 abc
P.2	34.6 def	3.4 cd	40 bcde	111 cdefgh	1.15 abcde	3.21 bc	151 a	162 abcdef
P.16	16.3 hij	24.2 a	24 def	68 hijk	1.47 abcd	4.12 ab	150 a	157 cdefg
Mark	25.1 fghi	10.8 abcd	27 cdef	86 fghij	1.06 cde	3.44 abc	136 ab	148 efgh
P.22	6.9 j	4.5 cd	7 f	23 k	0.99 de	3.36 abc	116 b	133 h
B.469	19.1 ghij	5.3 bcd	23 def	74 ghij	1.20 abcde	3.88 abc	133 ab	146 fgh
M.9 Fleuren 56	28.4 efgh	21.2 ab	46 abcd	106 defgh	1.68 a	3.83 abc	151 a	177 ab
M.9 NAKBT337	32.2 defg	9.2 abcd	52 abc	119 cdefg	1.63 ab	3.72 abc	156 a	178 a

[z] Means not followed by the same letter are significantly different at odds of 19 to 1.

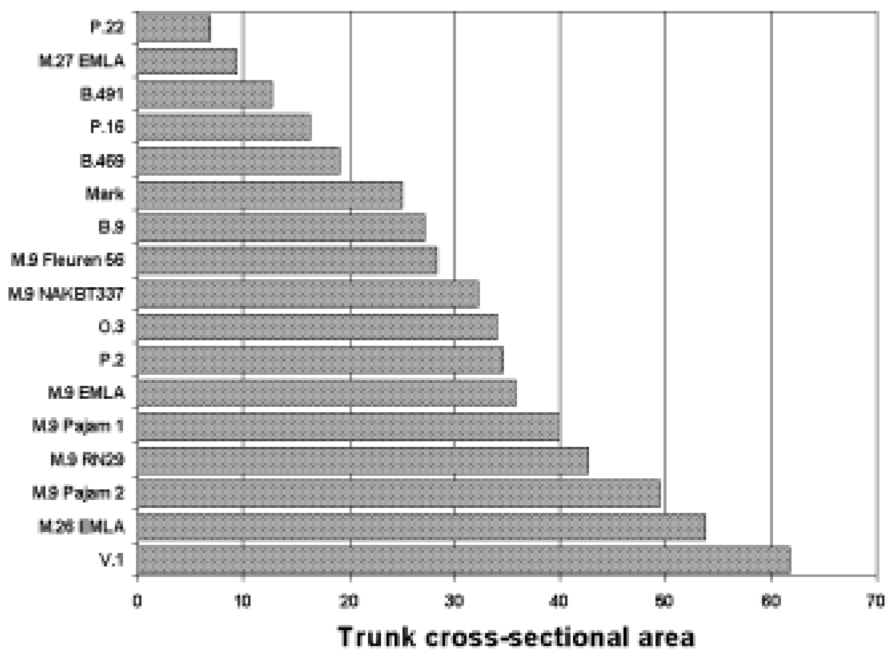

Figure 1. Trunk cross-sectional area (cm^2) of Gala trees on several rootstocks in the Massachusetts planting of the 1994 NC-140 Apple Rootstock Trial.

Technical Committee evaluates fruit-tree rootstocks throughout North America. A recent trial was established in 1994 at about 25 locations in the United States and Canada. It included Gala apple on 17 dwarfing rootstocks. Tree size (measured as trunk cross-sectional area), the number of root suckers, yield, and fruit size are assessed for each tree each year. Cumulative data from the first seven growing seasons of the Massachusetts planting of this trial are included in this article.

Trunk cross-sectional area is a universally used method to compare tree size of different treatments. It relates directly to the size of the canopy, and therefore allows a rough comparison of relative planting density. Even though all of the rootstocks included in this trial are considered dwarf, the trunk cross-sectional area varies greatly, from 6.9 cm^2 for trees on P.22 to 61.8 cm^2 for trees on V.1 (Table 1, Figure 1). These results show that P.22, M.27 EMLA, B.491, P.16, and B.469 likely are of little value, except with the very most vigorous varieties. Even with Gala (a relatively vigorous variety), these trees undoubtedly will "runt out" before the end of the trial. On the other end of the spectrum, V.1 produces a tree larger than does M.26 EMLA, and could be moved to the semidwarf category.

It is particularly interesting to compare the M.9 clones. Six are included in this trial, and they produce different sized trees. Trees on M.9 Pajam 2 had nearly twice the trunk cross-sectional area of trees on M.9 Fleuren 56 after seven seasons. The following M.9 clones are ordered from largest trees to smallest: M.9 Pajam 2 > M.9 RN29 > M.9 Pajam 1 > M.9 EMLA > M.9 NAKBT337 > M.9 Fleuren 56. This range of tree sizes suggests that growers planting trees on M.9 rootstock must be careful to know which clone they are purchasing and plan spacing of the trees accordingly.

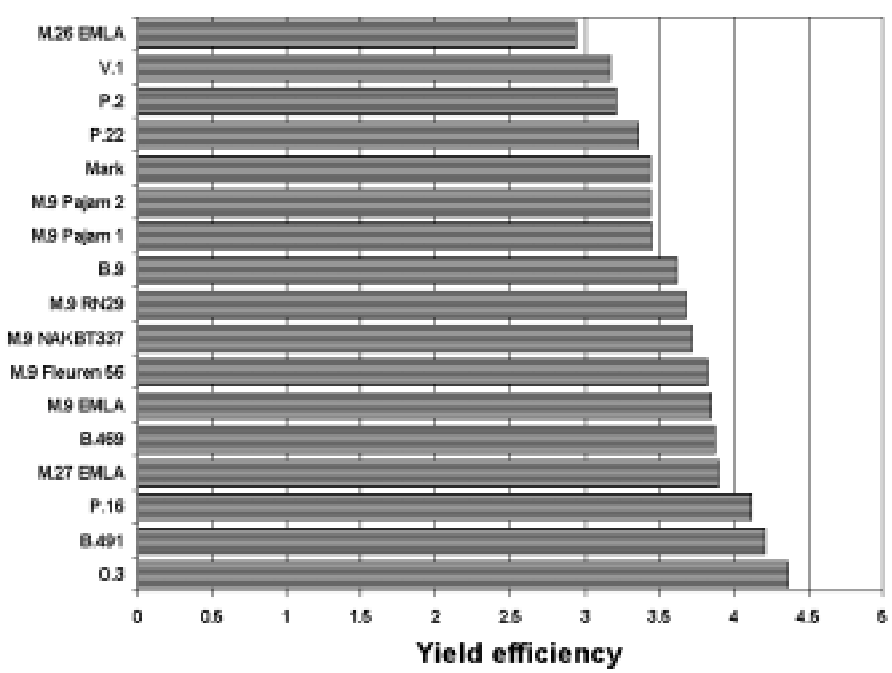

Figure 2. Yield efficiency (kg/cm^2 trunk cross-sectional area) of Gala trees on several rootstocks in the Massachusetts planting of the 1994 NC-140 Apple Rootstock Trial.

The most planted apple rootstock of the 1970's and 1980's, M.7, produces large numbers of root suckers. Growers tolerated this level of suckering, because M.7 resulted in a well-adapted, productive tree that was a dramatic improvement over seedling-rooted trees. Rootstocks which result in fully dwarf trees generally do not produce root sucker to anywhere near the extent that M.7 does. In this trial, M.9 Pajam 2 and P.16 generated the greatest number of root suckers, 23 and 24 per tree, respectively, in seven years (Table 1). Because of expected planting density, this level suckering would be a problem with P.16, possibly resulting in as many as 5,000 suckers per acre per year. Levels seen with other rootstocks likely would not present significant practical problems.

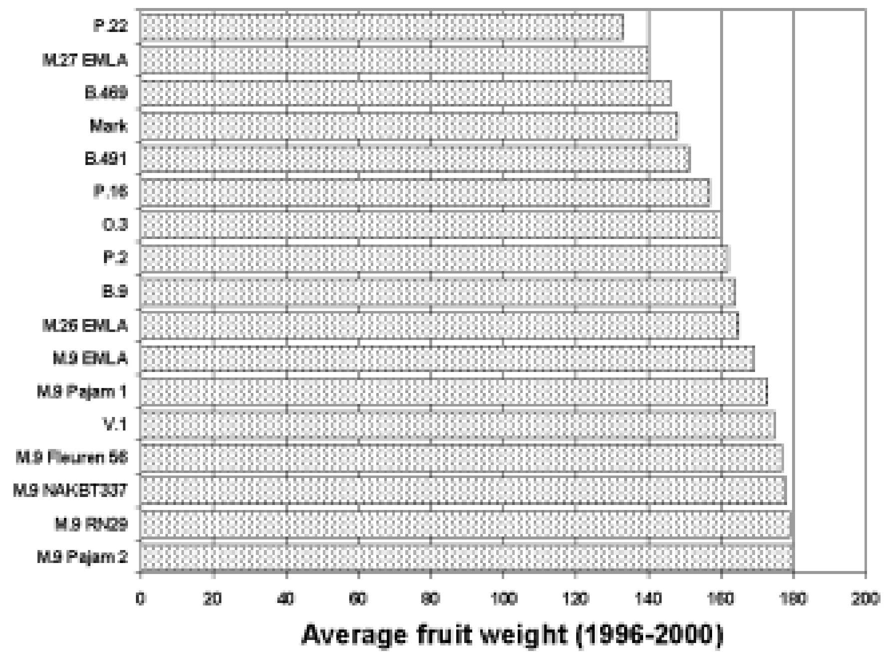

Figure 3. Average fruit size (g) from 1996-2000 from Gala trees on several rootstocks in the Massachusetts planting of the 1994 NC-140 Apple Rootstock Trial.

Obviously, yield is a major consideration when assessing rootstock performance. Actual yield per tree, however, is misleading. In this study (Table 1) as in many others, the yield per tree is more closely related to tree size than to rootstock directly. The ultimate assessment would be yield per acre, but that would require conducting an experiment first to determine tree size then a second experiment to compare rootstocks with each combination planted out at an appropriate spacing relative to tree size. Neither resources nor time are available to allow this approach. So, it is customary to use yield efficiency to relate yield to tree size. The relative differences in yield efficiency among rootstocks may reflect differences in potential yield per acre. Cumulative yield efficiency (1996-2000) does not vary greatly in this trial (Table 1, Figure 2). Very few statistically significant differences exist. It is possible to suggest that trees on O.3, B.491, and P.16 are more yield efficient than trees on M.26 EMLA. Also, trees on O.3 are more efficient than those on V.1 or P.2. Otherwise, the bulk of the rootstocks result in similarly efficient trees.

Fruit size can be affected by rootstock. In this trial averaged over all cropping years, size varied from just smaller than 100-count fruit (190 g) to just larger than 160-count fruit (120 g). Generally, the rootstocks that would be considered to have poor performance because of small fruit size were P.22, M.27 EMLA, B.469, Mark, B.490, and P.16. These are also the most dwarfing rootstocks. Generally, the M.9 clones resulted in the largest fruit over the five fruiting years of this study.

This study will conclude after three more seasons, but we can make some conclusions at this point:

1. P.22, M.27 EMLA, B.491, P.16, B.469, and Mark result in relatively weak trees that produce small fruit. It is likely that these rootstocks should be avoided except with the most vigorous scion cultivars.

2. Among the remaining rootstocks, yields per acre from appropriately spaced plantings will be similar.

3. M.9 continues to be a solid performer. Yield is good, and fruit size consistently is among the highest. It is important to understand differences among M.9 clones, however. Most of these differences relate to tree vigor. Trees on the most dwarfing M.9 clone (Fleuren 56) have about half the trunk cross-sectional area of trees on M.26 EMLA after seven growing season. Whereas, trees on the most vigorous M.9 clone (Pajam 2) are nearly as large as those on M.26 EMLA.

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