



# Size Controlling Apple Rootstocks

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There is currently much interest in Virginia in rootstocks that will control ultimate tree size. Several thousand semi-dwarf trees have been planted during the last few years, using mostly EM-VII as a clonal rootstock. There are several reasons for this interest. All of them have to do with increased production efficiency and improved fruit quality, especially with regard to color. Greater competition in the markets is forcing apple growers to intensify and refine production practices where possible.

Considerable work has been going on in this country testing the Malling rootstocks. More recently the Malling-Merton series has been introduced and some information is available. Some of these rootstocks have been tested in Virginia but none of them to the extent that unqualified recommendations can be made for this area. Quite often, plants which are adapted in one part of the country may not do at all well in another. On the other hand, some stocks may be adapted to a wide range of conditions.

## GENERAL CONSIDERATIONS

Each rootstock of the Malling and the Malling-Merton series has good and bad points. It is important to make a careful study of each stock before selecting the one to fit an individual need.

Stocks vary in the degree of dwarfing influence they exert on the tree. The variety that is budded or grafted onto the stock will also have an influence on the size of the tree because varieties of apples differ in vigor.

Interest in size-controlling rootstocks and spur type trees began to increase at about the same time. For this reason there is some confusion about them. There are several different rootstocks which affect mature tree size. This reduction in tree size is caused by the dwarfing influence of the rootstock on the scion variety. In contrast, the spur type tree is smaller than standard trees because of the growth habit of the scion variety. On this tree, fruit spurs are formed on the large limbs and the tree never attains the size generally expected of standard trees. So, one type of tree is dwarfed because of the rootstock and the other because of the growth habit of the scion variety. Generally, spur type trees have been propagated on seedling rootstocks.

An important thing to remember when considering Malling and Malling-Merton stocks is the many possible stock-scion combinations that can be made with them. It is just as important to select the right stock as it is the proper variety. Several nurseries are now offering a selection of stocks of the Malling series and a few have some Malling-Merton stocks with several varieties

available. Unless something happens to reverse the trend, this practice will continue and selections from nurseries will increase. Limited numbers of stocks are being released periodically for testing and, as these are released for commercial use, they will add to the number now available. This simply means that a grower must become familiar with the stocks that are now being used and stay abreast of the changes in the future.

The rootstock descriptions in this circular are not intended to be complete. Only those that show promise for commercial planting in Virginia at present are included. Each grower should take advantage of every opportunity to observe these stocks both in test plantings and commercial plantings and become acquainted with them. Another possibility would be to use some of them as replants in established orchards, if a complete planting is not desirable. This would allow for close observation under commercial conditions.

Any planting of new rootstocks involves some risk and a testing program is of long duration. Commercial plantings will be made prior to the time that reliable information is available under Virginia conditions. In such cases Malling VII is suggested as offering the least amount of risk of any of the size-controlling stocks. It has performed well under a wide range of growing conditions of different soil types and soil temperatures. This is a fairly reliable indication that it will be adapted to the growing conditions in Virginia.

Several observations have been made concerning general cultural methods for the smaller than standard trees. The use of this type of tree indicates a more intensified system of culture along with more attention to the details of pruning, weed control, fertilization, and other production practices.

Planting distances should be varied according to the soil type and other factors. The suggested spacings are for planting in a good loam soil. In light soils trees may be planted somewhat closer

Suggested Planting Distances with  
Plants Required Per Acre

Rootstock	Distance in feet between trees and rows	Trees per acre
EM-IX (Clonal).....	8 x 18	302
EM-IX (Interstem, seedling rootstock)....	12 x 22	165
EM-VII.....	18 x 28	86
MM-106.....	18 x 28	86
EM-II.....	20 x 30	72
MM-III.....	20 x 30	72
MM-104.....	22 x 32	62
MM-109.....	25 x 35	48

together. There are several other planting plans which may be devised, using closer spacings in the row and between rows. Such plans have the advantage of increasing early yields per acre because of the increased number of producing units. Initial cost of this system is higher than the usu-

al methods because of the number of trees involved, but early heavy production should offset this cost. Definite plans must also be made concerning the removal of some trees when crowding becomes a factor in production.

## ROOTSTOCK DESCRIPTIONS

### East Malling Stocks

#### EM-IX (Clonal)

This is a true dwarfing stock. The bark on the roots is twice as thick as on seedling or other stocks in the EM series. Because of this, the roots are brittle and break easily. Varieties grown on EM-IX (Clonal) must be given some support, such as a wire trellis or posts.

EM-IX encourages early fruiting. It is widely used in Europe but has not been generally accepted by growers in this country. Some favorable results have been obtained by using this stock in a hedgerow system to obtain early and heavy production. One drawback is the large number of trees needed to set an acre, resulting in high initial cost. The support required is also a big cost at the beginning of planting. Early yields of good quality fruit, however, may quickly offset this cost. Varieties on this stock may also be used as fillers or set in vacant spaces in the orchard to provide pollination. Under good growing conditions it will make considerable bloom the second year. Maximum production per tree is usually around 3 bushels.

#### EM-IX (Interstem)

Because of the poor anchorage of EM-IX on its own roots, research work has been carried out to eliminate this hazard but to retain the good qualities of EM-IX. The technique employed is to use a strong growing rootstock such as a seedling, EM-XII or EM-XVI, and then graft a section of EM-IX onto the root system. Then the desired variety is budded or grafted onto the EM-IX section. The length of the section of EM-IX is usually 5 to 6 inches.

Trees on this type of stock do not normally require support because of the stronger root system. They will usually be somewhat larger than trees on Malling-IX roots and must be spaced accordingly. The purchase price is higher than others because of the additional labor cost of producing them. The normal length of time to produce this tree is 2 years; however, some good ones have been grown in one year by making both bench grafts at the same time and then setting it in the early spring to provide a long growing season.

#### M-26

This stock is the result of a cross of M-IX and M-XVI. Trees on this rootstock are larger than those on M-IX but smaller than those on M-VII. The anchorage of trees on M-26 is better than that of those on M-IX, but not as good as with trees on M-VII or MM-106. Some type of support will probably be necessary with this stock, except

### Apple Rootstock Characteristics

Rootstock	Growth effect upon a variety	Good Properties	Bad Properties	Remarks
EM-IX (Clonal)	Very dwarfing	Induces early bearing	Root system brittle, tree needs support	Used for strong growing varieties
EM-IX (Interstem, seedling rootstock)	Very dwarfing	Induces early bearing. Tree does not generally require support		Used for strong growing varieties
EM-VII	Moderately dwarfing	Roots easily. Widely adapted	Suckers if planted too shallow	A true semi-dwarf
MM-106	Moderately dwarfing. Mature tree about same size as EM-VII	Does not produce suckers like EM-VII. Woolly aphid resistant		Better than EM-VII on light soils. Limited data on performance in U. S.
EM-II	Slightly dwarfing	Induces early bearing	Susceptible to low temperature injury	Best used for varieties that are not strong growers
MM-III	Slightly dwarfing. Mature trees about same size as EM-II	Heavy producer. Woolly aphid resistant		Withstands drought better than EM-II. Limited data on performance in U. S.
MM-104	Slightly dwarfing. Mature trees larger than EM-II	Good anchorage. Woolly aphid resistant. Induces early bearing. Heavy producer		One of the most promising of the MM stocks. Limited data on performance in U. S.
MM-109	Slightly dwarfing. Mature trees about standard size	Induces early bearing. Woolly aphid resistant		Limited data on performance in U. S.

in highly protected locations. M-26 induces early bearing, and total yields per tree have been good in tests in England. This stock was released in this country only a few years ago and trees will be available from nurseries within the next 2 years. It does not have resistance to woolly aphids, and information on its performance in this country is not available.

#### EM-VII

This stock has received more attention by nurserymen and growers than any other to date. It has been widely planted and in practically all cases has performed well. The mature size of the tree is about  $\frac{2}{3}$  that of the same variety on seedling rootstock. It is easy to propagate and induces early bearing. Yields have been good. However, in tests in New York State, EM-II with Red Delicious yielded more than EM-VII and Red Delicious. At the time the records were taken the trees were 14 years old.

EM-VII has a good root system, but under strong winds trees on this stock have not been as well anchored as some others. To reduce this problem it is rather common practice to plant the trees from 4 to 6 inches deeper than they stood in the nursery row. The propagator must make allowance for this and bud or graft the stocks at a height that will allow for this method of planting. Care must be taken to avoid planting the tree to a depth where scion rooting will take place.

#### EM-II

Varieties on this stock will make larger trees than on EM-VII. In New York EM-II is prefer-

red as a stock for varieties similar to Yellow Transparent and Rome Beauty which by nature do not develop into large trees. It has a strong root system and grows well on a wide range of soil types. It appears to tolerate dry soils well and induces bearing at an early age. EM-II may not be widely accepted in Virginia because it does not have enough dwarfing influence on tree size. It is also more difficult for nurserymen to propagate than some of the others.

#### Malling-Merton Stocks

The Malling-Merton series of stocks were released for testing in this country in 1952. Four rootstocks were introduced as clonal stocks and were named MM-104, MM-106, MM-109 and MM-111, and are highly resistant to woolly aphids. All of them are the result of a cooperative breeding project by the John Innes Horticultural Institution (formerly situated at Merton) and the East Malling Research Station in England. Another clone selected from this project proved to have outstanding vigor but was not sufficiently resistant to woolly aphids to be included in the MM-series. So, it was added to the Malling rootstocks as M-XXV. These crosses were made more than thirty years ago, and they have been given considerable testing in England. However, they have been tested in this country such a short time that accurate information under our conditions is not available. They may be obtained from nurseries with a selection of varieties. Most of the information presented here is based on their performance in England.

#### MM-106

This stock is similar to EM-VII in several respects. Mature trees on both are about the same size, and yields of fruit have been comparable. MM-106 has some advantages over EM-VII. It does not have the habit of suckering from the roots and the performance of MM-106 has been better than EM-VII on lighter soils. In addition, MM-106 has the added benefit of being woolly aphid resistant.

#### MM-104

Mature trees on this stock are slightly larger than those on EM-II. It is a cross of EM-II and Northern Spy and the woolly aphid resistance comes from Northern Spy. This is the most promising stock of the MM-series according to tests in England. It induces early heavy production and has a very strong root system. The mature tree size is rather large, especially since it produces early heavy crops. This may be somewhat of a disadvantage to growers interested in a semi-dwarf tree. MM-104 is rather sensitive to damage

by water-logged soils, so it should be planted in well drained locations.

#### MM-109

MM-109 is another selection of a cross between EM-II and Northern Spy. Mature trees are near standard size. It is classified in the very vigorous group and may have a place where large-sized trees are desired. Other than this, MM-109 would seem to have nothing more to offer than MM-104.

#### MM-111

Trees on MM-111 stocks are slightly smaller than those on MM-104. Both are classified in the vigorous group. MM-111 does not have quite as good a record on early bearing as MM-104, but at 15 years of age trees on MM-104 only have a slight lead in yield over those on MM-111. MM-111 is more drought resistant than any of the other stocks mentioned, and where insufficient rainfall is a factor in production this stock should certainly be given consideration. It is resistant to woolly aphids.



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