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Fig. 1.—Left: 8-year-old Jonathan on MM106 (Semi-Dwarfing). Right: 8-year-old Jonathan MM111 (Vigorous).

Photo—East Malling Research Station.

ENGLISH FRUIT TREE ROOTSTOCKS

By J. CRIPPS, B.Sc. (Hort.), Horticultural Adviser.

THE present-day fruit tree consists of two interdependent parts—the stock or root system and the scion or above ground portion. The scion naturally gains most prominence, as it is the part of the tree with which the grower is mainly concerned in orchard management and also the portion which provides him with his income. Nevertheless, the rootstock can exert a profound influence on tree performance. For instance, such factors as root anchorage, root penetration, drought resistance, resistance to pests and diseases, susceptibility to mineral deficiencies, growth characteristics of the tree and its ultimate size, its time of flowering, setting, fruit size and colour, period of ripening and the quality of the fruit can all be affected by the choice of rootstocks.

APPLE ROOTSTOCKS

In view of the profound influence of rootstocks on tree performance, fruit growers may be interested in developments in this field in England.

Some 35 years ago, work was commenced at the East Malling Research Station to develop rootstocks of known characteristics. This was occasioned by the unsatisfactory position which existed prior to this time, when only two stocks were recognised, namely Crab and Paradise. Crab was only suitable for very large trees grown in grass, such as cider varieties, and both it and Paradise showed considerable variation in vigour. To clarify the position, Paradise stocks collected from nurserymen all over Europe were grown at East Malling

and segregated according to vigour. Eventually it was found that the so-called Paradise stock could be separated into no less than sixteen distinct types, varying widely in characters and these were numbered M I to M XVI. These differences also showed in the vigour of the scion varieties worked on them. For instance, trees worked on the vigorous stock grew almost three times as large as those on the most dwarfing.

This original range of Malling rootstocks are, however, all susceptible to woolly aphid attack and may therefore not be acceptable here, but they form the basis of later ranges of rootstocks and will be described for the sake of continuity. They have been adopted widely in Europe



Fig. 2.—8-year-old Jonathan on MM115 (Very Vigorous).
Photo—East Malling Research Station.

and introduced into North America where some of them are becoming popular. The most satisfactory members of the series are as follows:—

M IX.—This produces very small trees which require staking, particularly on poor soils. It is used for “filler” trees between permanent plantings but in one well-known orchard on rich soil in Hampshire, England, where rainfall is fairly high, the “permanent” planting has been removed and the filler trees on this stock left to form a highly productive orchard. M IX is an ideal stock for small trees for the garden, e.g. dwarf pyramids and cordons.

M VII.—A semi-vigorous rootstock which is said to be susceptible to Crown Gall. Although not widely planted, where used it has given good results.

M IV.—This stock is interesting since of the original series it gives rise to the heaviest cropping trees, but since its anchorage is very poor it is seldom employed.

M II.—By contrast, M II is a well anchored stock. Seventy-five per cent. of English commercial apple plantings are on this stock and varieties budded on it are fairly vigorous, growing steadily and persistently until they reach a considerable age under good management. Stoolbeds of M II produce up to 60,000 stocks per acre annually.

M I.—M I is similar to M II in vigour, but does not thrive under dry conditions. It has however found favour in the United States.

M XII.—This is a very vigorous rootstock and trees on it take longer to come into bearing except perhaps on poor soil. It is deep rooted, superbly anchored and said to be “suitable for climates of abundant sunshine where fruit bud formation is at a high level” and might therefore give rise to an excellent stock if crossed with Northern Spy to add resistance to woolly aphid to its virtues.

M XVI.—M XVI is very susceptible to woolly aphid attack and tends to grow late into the autumn, two disadvantages under local conditions, but it propagates well and produces vigorous trees which commence to crop fairly early in their lives.

Most of the stocks described above have disadvantages—some more than others. M II probably has the least and has proved very reliable.

Subsequently a series of four stocks was produced at the John Innes Research Station at Merton and these are known as Merton 778, 779, 789 and 793. All are crosses between Malling II and Northern Spy and are woolly aphid resistant.

None of the stocks which bear the prefix “Merton” is dwarfing and they range in vigour from moderately to very vigorous. Number 779 was not included in the original trial in England using Lane’s Prince Albert as a scion variety, where of the remainder 789 was found to be the most vigorous, followed by 778 and 793 in that order. Measurements of weight of crop produced placed the three stocks in the same order, but 789 was found to have a lower ratio of blossom buds to new wood growth than the other members of the series.

All four were, however, included in a trial using Dougherty as the scion variety

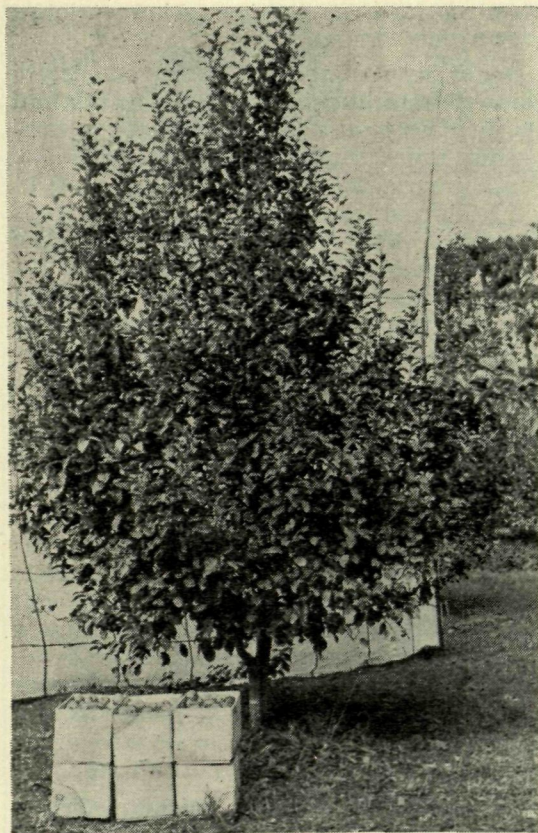


Fig. 3.—Dougherty on Merton 779.
Photo—J. W. Endt.

carried out by the New Zealand Department of Agriculture but all trees on 789 were affected by collar rot and figures for growth and cropping relating to these cannot be considered valid. Merton 799 was found to be the most vigorous, followed by 778 and 793.

Under New Zealand conditions both 779 and 793 cropped heavily and seemed to be the outstanding members of the series, the former for the production of large trees, while scions on the latter showed only moderate vigour.

In 1928 an extensive breeding programme was commenced at East Malling Research Station with a view to obtaining an improved series of rootstocks resistant to woolly aphid attack.

Northern Spy was used as one parent with the intention of conferring woolly aphid resistance, and crosses were made with the various Malling rootstocks. The

John Innes Research Station, then enduring the "smog" at Merton near London, was called in to aid East Malling in the work and altogether over 3,500 seedlings were bred. All were tested for susceptibility to woolly aphid and many eliminated on this count, while others were discarded, due to their low powers of reproduction, poor root systems and other undesirable qualities, thus substantially reducing the numbers to be tested in the field. It is notable that the majority of the recommended members of this series are crosses between Northern Spy and Malling II, the best of the original English series.

Finally 15 resistant stocks known as Malling-Merton and numbered MM 101 to MM 115 were selected and described. These all propagated readily by the stooling method. A further field trial was carried out using scions in selected varieties to compare them with rootstocks of the



Fig. 4.—Dougherty on Merton 793.
Photo—J. W. Endt.

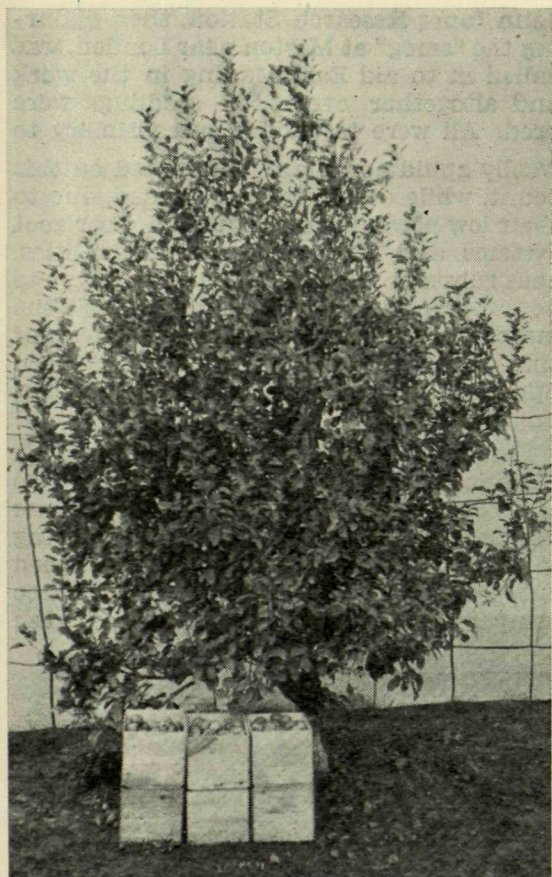


Fig. 5.—Dougherty on Northern Spy No. 1.
Photo—J. W. Endt.

Malling series as well as Northern Spy. The trees were pruned by the regulated method, which merely involves the thinning out of overcrowded wood, to induce early cropping. Shoot growth, trunk girth, and later, yields were measured.

The three scion varieties chosen were Cox's Orange Pippin, Ellison's Orange and Jonathan. The first-named is of course the standard English dessert apple, but the last is of greater interest since it is one of the very few apple varieties having an almost world wide distribution, being grown in America, England (where it is known as Bowden's seedling), Europe and Australia. It is, however, a late variety in countries with a temperate climate such as England. It is interesting to note that there was little difference in the reaction of the three varieties to the new rootstocks which

would suggest that other scion varieties might react similarly.

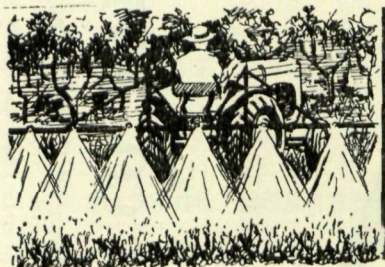
Generally the Malling-Merton stocks are much better anchored than the original Malling series and give rise to more precocious trees than do their predecessors. Furthermore, the scion varieties used in the trials yielded as heavy or heavier crops compared with those budded on to the earlier series of stocks. Trees on MM 104 gave the heaviest crops and are described as semi-vigorous, being comparable in that respect to trees on M IV. MM 106 represents an improvement on M VIII. MM 109 is a vigorous drought resistant stock, trees on which withstood the very dry summers of 1947 and 1949 better than those of Northern Spy. MM 111 is similar in many respects to M II but gave slightly heavier crops and M XXV, although not woolly aphid resistant is recommended as a very vigorous rooststock to replace M XVI. The stocks listed above are those passed as suitable for distribution to nurserymen in England. For local use, where woolly aphid resistance is desirable, MM 115 may be more suitable than M XXV; it appears to be a vigorous stock which is satisfactory in all respects.

The parentage of the Malling-Merton stocks mentioned is as follows:—

- MM 104 Malling II crossed with Northern Spy.
- MM 106 Malling I crossed with Northern Spy.
- MM 109 Malling II crossed with Northern Spy.
- MM 111 Merton 793 (Malling II x Northern Spy) crossed with Northern Spy.
- MM 115 Malling II crossed with Northern Spy.
- M XXV Malling II crossed with Northern Spy.

In the field trials conducted in England one planting was on a soil described as sandy loam with loam with gravel and the other on a loamy soil. The actual mean total yield per tree in pounds of the three scion varieties for the period 1948 to 1952 is given in the table below. Various members of the original Malling series of stocks as well as Northern Spy and Ivory's Double Vigour, a New Zealand stock, were included for the sake of comparison.

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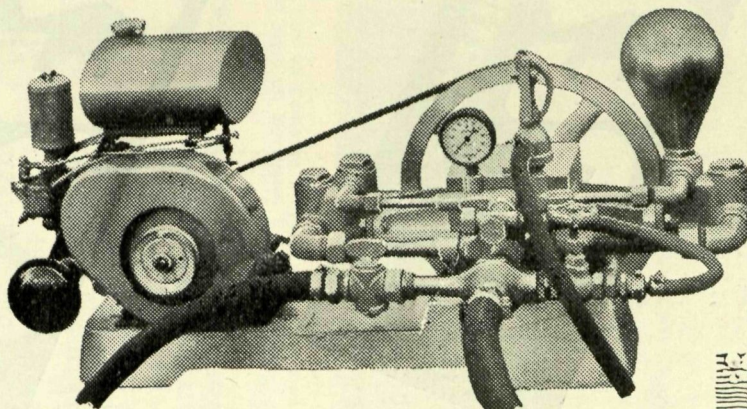
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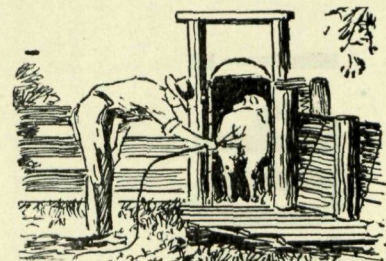
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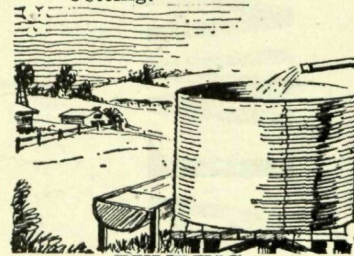
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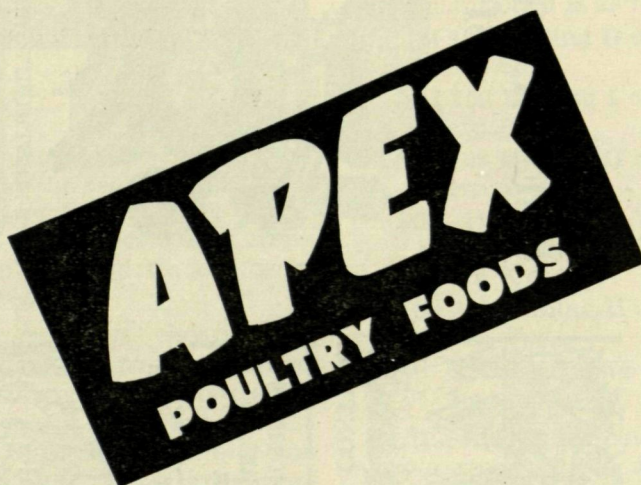
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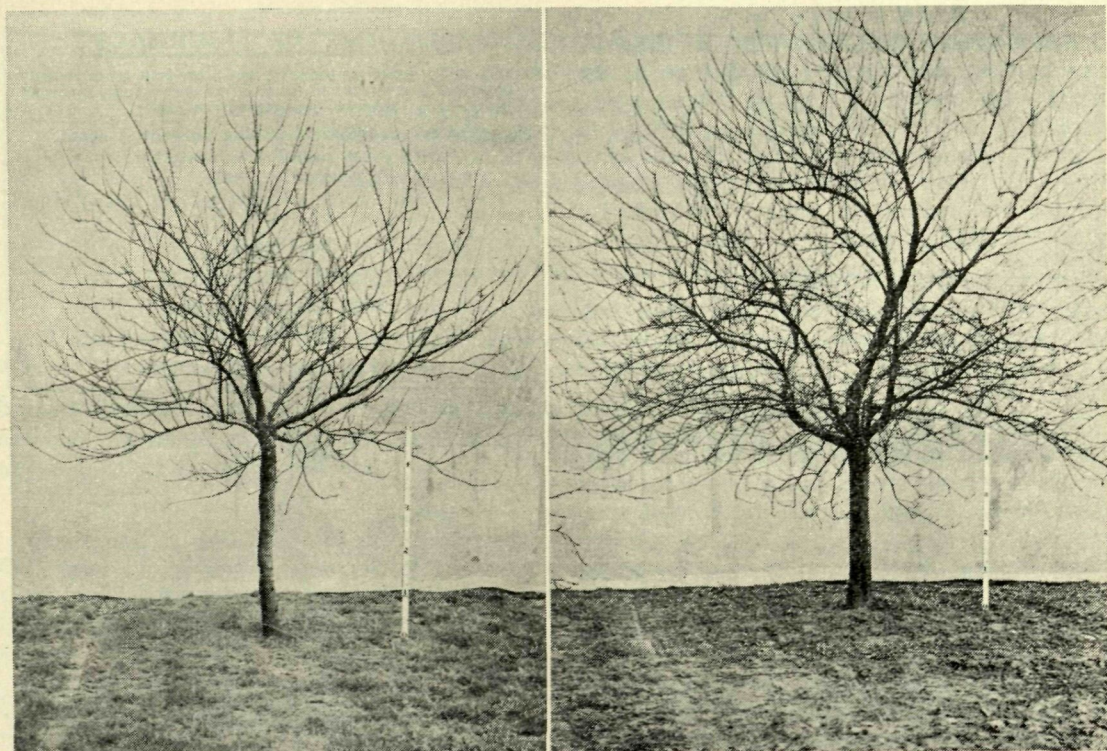


Fig. 6.—Left: 12-year-old Cambridge Gage plum on Common Plum Stock (Semi-Dwarfing). Right: 12-year-old Cambridge Gage plum on Myrobalan B (Very Vigorous).
Photo—East Malling Research Station.

| Rootstock. | Yield on Loamy Soil. | Yield on Sandy Soil. |
|----------------|-------------------------|-------------------------|
| MM 101 | 114.5 | 61.8 |
| MM 102 | 115.0 | 36.6 |
| MM 103 | 166.8 | 71.9 |
| MM 104 | 196.3 | 69.4 |
| MM 105 | 133.0 | 67.9 |
| MM 106 | 127.9 | 51.3 |
| M IV | 172.8 | 73.3 |
| M VII | 134.1 | 61.9 |
| M IX | 66.4 | 31.1 |
| Northern Spy | 166.3 | 50.8 |
| MM 107 | 91.3 | 59.2 |
| MM 108 | 133.9 | 33.0 |
| MM 109 | 146.7 | 82.8 |
| MM 110 | 137.0 | 83.9 |
| MM 111 | 153.1 | 69.5 |
| MM 112 | 120.2 | 55.7 |
| MM 113 | 143.4 | 68.5 |
| MM 114 | 134.1 | 51.2 |
| MM 115 | 170.1 | 63.6 |
| Ivory's Double | | |
| Vigor | 192.6 | 66.6 |
| M I | 105.9 | 37.5 |
| M II | 109.2 | 55.6 |
| M IV | 193.5 | 67.9 |
| M XVI | 190.0 | 57.1 |
| M XXV | 158.0 | 66.8 |

The important fact which emerges from this table is that Northern Spy cropped well (though not as well as MM 104 or

MM 115) on the better soil where moisture stress was of comparatively minor importance, but on the relatively poor sandy soil where it was subjected to drought conditions in 1947 and 1949, most of the Malling-Merton stocks surpassed it in productivity.

MM 109 gave a yield of 63 per cent. greater, according to the figures published above, than Northern Spy which indicated that the latter may not be the ideal stock for under conditions of summer drought.

These stocks have been selected with an eye to their ease of propagation by means of stooling, which is the standard method of pome rootstock propagation in use in Europe. Stoolbeds should produce approximately 30,000 stocks per acre per annum. Stocks are not raised by every nursery, but are usually supplied by a few firms in England and Holland, which mass produce them. Rootgrafting is never practised, for scion rooting must be prevented at all costs since the stock must be allowed to exert its full influence on the scion variety.

PEAR ROOTSTOCK

Pears grown commercially in England are in the main budded on Quince A, the most vigorous of a set of three semi-dwarfing quince rootstocks (Quince A, B and C). These were selected at East Malling, and form trees similar in size to apples on Malling II, that is suitable for planting 24ft. apart.

PLUM ROOTSTOCK

Various plum rootstock have been collected and classified according to vigour by East Malling and of these, three are worth mentioning, viz.:

Myrobolan B, which is commonly used for cooking plums in England and produces vigorous trees. It is easy to layer and strikes readily from hardwood cuttings.

Brompton.—This stock is preferred for some high quality dessert plums and for peaches and nectarines on heavy "wet" soils where seedling peach stock tends to die out. It is also used for apricots and is comparable in vigour to Myrobolan B but does not propagate quite so readily by layering.

St. Julian A.—Until recently only one semi-vigorous rootstock, Common Mussel, was available for plums, but this stock tends to sucker profusely and to dry out in the budding season. Moreover, it does not layer well although it can be propagated in quantity by means of root cuttings. St. Julian A, however, does not sucker and layers well. It is compatible with all plum and apricot varieties and gives rise to trees of medium vigour which come into bearing early.

All the deciduous rootstocks described have been developed as the result of painstaking investigations at the East Malling and John Innes Research Stations. Their findings of course apply to conditions in England, but with the wide range of variation in vigour and tree performance exhibited by the various stocks, particularly apple stocks, there is little doubt that some at least would be suited to local conditions.

Arrangements are being made to introduce a small quantity of apple rootstocks in the coming season and these will be subsequently tested at the Horticultural Research Station, Stoneville.

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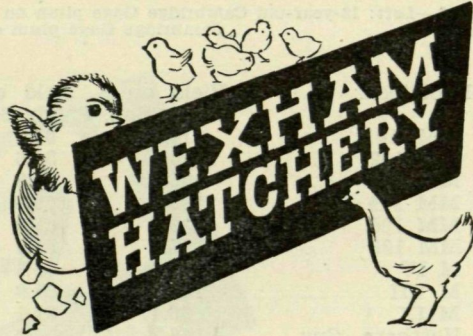
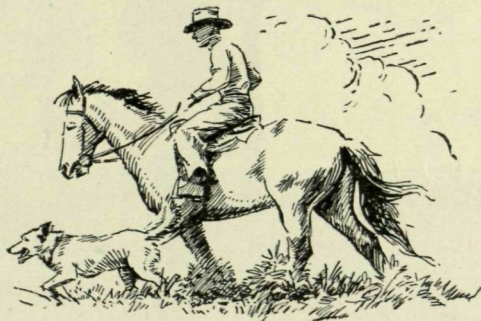
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