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STOCK AND SCION INVESTIGATIONS. XII. JONATHAN APPLE ON MALLING–MERTON, MALLING AND NORTHERN SPY ROOTSTOCKS

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SUMMARY

Results are reported from a 15-year-old apple rootstock trial at Applethorpe, using the variety Jonathan as the scion on a range of Malling-Merton rootstocks (MM107, MM108, MM109, MM110, MM111, MM113, MM114 and MM115), Malling 411, Malling 279, Malling XXV and Northern Spy.

Trees on the rootstock MM109 had the largest girth, carried the heaviest crop and exhibited precocity in bearing.

The very vigorous stocks MM113 and MM115 produced larger trees and heavier crops than did Northern Spy. Trees on Northern Spy outgrew and outyielded trees on MM111.

The large trees on MM114 were slow in coming into full bearing.

Mean fruit weight has been commercially acceptable over several seasons, including the 1964-65 drought year, for trees on MM109, MM114, Malling 411 and Northern Spy rootstocks. Trees on MM110 produced the smallest fruits.

I. INTRODUCTION

Dickson and Thomas (1938) reported that apple trees on Northern Spy rootstock often do not produce satisfactory yields when planted at standard distances apart (20 ft x 20 ft) on the infertile or eroded soils of the Granite Belt.

Since that time, trials have proceeded with rootstocks which are immune to woolly aphid with the object of improving the yield per acre and tree anchorage (Thomas 1945).

A selection from the Malling-Merton (MM) series of apple rootstocks, together with others of the same breeding, was introduced from East Malling Research Station in 1947 to permit comparison with Northern Spy rootstock.

II. MATERIALS AND METHODS

The rootstocks included in this trial were MM107, MM108, MM109, MM110, MM111, MM113, MM114, MM115, Malling XXV, Malling 279 and Malling 411 from the same breeding programme, and Northern Spy. The scion variety Jonathan was chosen because of its world-wide importance, its sensitiveness to stock-induced vigour, and its capacity for early and heavy bearing at Stanthorpe.

The soil in the experimental area was an infertile sandy podsol derived from an acid granite. The medium-sized indigenous trees were removed in 1949, some 18 months before planting, in order to permit adequate soil preparation and the installation of a tile drainage system.

The trees were planted in 1950 at 20 ft apart on the square system with 20 replications of the 12 rootstock treatments in randomized blocks containing single-tree plots. Sufficient Granny Smith trees were interplanted between the blocks for cross-pollination purposes and all Jonathan trees were within three rows from the pollenizer variety.

The trees were pruned to a vase shape. At each winter pruning, two-thirds of the leader growth was removed. Lateral shoots less than 12 in. long were left unpruned in the first year of growth and cut back the next year to stimulate spur development; laterals more than 12 in. long were pruned back to five buds. Sub-leaders were developed during the first 5 years to fill in spaces between the leaders. The framework of the established trees was held in position by a rope or wire tie after it had carried the first heavy crop and achieved sufficient spread.

The annual spring dressing was an organic fertilizer containing 10·0% N, 9·8% P_2O_5 and 7·5% K_2O applied at the rate of 6 lb per bearing tree. Possible deficiencies of copper, zinc and boron were guarded against by precautionary sprays of the respective soluble salts. Standard spray programmes were used to combat insect pests and diseases and to maintain the trees at their maximum cropping capacity. Weeds and grasses were suppressed in summer and spring by cultivation, but after the completion of harvesting they were allowed to grow unchecked. Green-manure crops of rye or lupins were sometimes grown in winter.

Trunk girth at a fixed height of approximately 9 in. above the union was measured annually to give an indication of tree vigour.

The crop, including windfalls, was weighed each year, usually at two successive pickings. Samples of 100-200 fruits were picked at random from each tree and weighed to determine the effect, if any, of rootstock on fruit size.

III. RESULTS

Trunk girth.—The girth measurements of the experimental trees at 15 years after planting are presented in Table 1.

The largest trees were on MM109, followed by a group of trees on the very vigorous rootstocks MM113, MM114, and MM115. Northern Spy conferred only moderate vigour on the scion but the trees were larger than those on MM110

TABLE 1

JONATHAN ROOTSTOCK TRIAL: GROWTH AND ACCUMULATED CROPPING DATA

Mean Girth (cm) 1965		Accumulated Crop (lb per tree)			
		1958–1961		1958–1965	
MM 109	42·54	MM 109	362·7	MM 109	1,409·1
MM 113	39·61	MM 115	325·3	MM 115	1,205·4
MM 114	39·45	M 279	317·8	MM 113	1,132·4
MM 115	38·63	MM 113	312·1	M 411	1,128·9
M 279	37·24	M 411	298·7	M 279	1,109·9
M XXV	36·27	N. Spy	270·5	MM 114	1,086·2
M 411	34·79	MM 114	268·5	M XXV	991·0
N. Spy	32·21	M XXV	268·2	N. Spy	931·5
MM 107	31·17	MM 110	248·0	MM 108	802·0
MM 108	31·14	MM 108	225·1	MM 110	772·2
MM 111	28·67	MM 107	209·8	MM 111	682·9
MM 110	28·65	MM 111	209·8	MM 107	669·8
109 > 115 ⩾ 279, XXV, 411, Spy, 107, 108, 111, 110		109, 115, 279, 113 > 411 ⩾ Spy, 114, XXV, 110, 108, 107, 111		109 > 115 ⩾ 113, 411, 279, 114, XXV, Spy, 108, 110, 111, 107	
113 > XXV ⩾ 411, Spy, 107, 108, 111, 110		115 > Spy, 114, XXV ⩾ 110, 108, 107, 111		115 > XXV ⩾ Spy, 108, 110, 111, 107	
114 ⩾ 411, Spy, 107, 108, 111, 110		279 > 110 ⩾ 108, 107, 111		113 > Spy ⩾ 108, 110, 111, 107	
115 > 411 ⩾ Spy, 107, 108, 111, 110		113 > 110 ⩾ 108, 107, 111		411 > Spy ⩾ 108, 110, 111, 107	
279 ⩾ Spy, 107, 108, 111, 110		411 ⩾ 108, 107, 111		279 ⩾ 108, 110, 111, 107	
XXV > Spy ⩾ 107, 108, 111, 110		Spy > 107, 111		114 ⩾ 108, 110, 111, 107	
411 > 107, 108 ⩾ 111, 110		114 > 107, 111		XXV > 110 ⩾ 111, 107	
Spy > 111, 110		XXV > 107, 111		Spy > 111 ⩾ 107	

and MM111. Trees on the rootstock MM111 produced relatively small fruits, comparable to those described by Preston (1962) from an infertile soil overlying chalk. When compared with trees on MM113, those on Malling 411 had a relatively small girth for the amount of crop carried.

Cropping.—Cropping data are also presented in Table 1.

The largest total crops were from trees on MM109; these outyielded all others from the commencement of cropping, as is shown in the accumulated cropping for the period 1958 to 1961. Trees on other vigorous rootstocks in the trial, such as MM115 and MM113, also cropped heavily. Production from trees on Northern Spy was moderate but exceeded that from trees on MM111 and MM107. The crop harvested from trees on MM109 was more than double that from trees on MM111 and MM107 at 15 years.

Fruit size.—Table 2 records the mean fruit weights in random samples collected from each tree in 1964, 1965 and 1966, together with mean crop weights per treatment.

TABLE 2

JONATHAN ROOTSTOCK TRIAL: MEAN WEIGHT PER 100 OR 200 FRUIT AND MEAN CROP PER TREE

—	1964		1965		1966	
Rootstock	100 Fruit Weight (lb)	Crop per Tree (lb)	200 Fruit Weight (lb)	Crop per Tree (lb)	100 Fruit Weight (lb)	Crop per Tree (lb)
MM 111	30·30	133·1	35·37	103·0	20·94	83·2
N. Spy	32·95	164·8	34·44	139·1	22·30	126·7
MM 107	30·91	108·6	33·75	104·7	21·58	86·5
MM 109	32·05	302·8	32·94	210·9	22·92	216·0
M 411	32·02	243·2	32·56	167·2	22·90	157·4
MM 114	32·15	251·9	32·50	161·9	22·72	195·2
M 279	30·77	234·3	31·44	143·7	22·07	167·6
MM 108	31·42	154·1	30·81	119·6	22·97	103·4
MM 113	29·67	245·5	29·94	145·5	21·82	167·6
M XXV	30·85	209·8	29·37	145·6	22·37	138·0
MM 115	31·29	243·7	29·31	175·7	20·92	172·7
MM 110	28·63	153·6	27·31	98·2	20·92	92·6

Significant differences for fruit weight—

Spy > 108 > 115 ⩾ 107 ⩾ XXV, ⩾ 279 ⩾ 111 ⩾ 113 ⩾ 110	111 > 108, 113 ⩾ XXV, 115, 110	108 > 111 > 115 > 110
114 > 111 ⩾ 113 ⩾ 110	Spy > 113, XXV, 115, 110	109 > 111 > 115 > 110
109 > 111 ⩾ 113 ⩾ 110	107 > XXV, 115 ⩾ 110	411 > 111 > 115 > 110
411 > 111 ⩾ 113 ⩾ 110	109 ⩾ 110	114 > 111 > 115 > 110
108 > 113 ⩾ 110	411 > 110	
115 > 113 ⩾ 110	144 > 110	
107 ⩾ 110		
XXV ⩾ 110		
111 ⩾ 110		
279 ⩾ 110		

Significant differences for annual crops—

109 > 114 > 113 > 115 > 411 ⩾ 279 ⩾ XXV ⩾ Spy ⩾ 110 ⩾ 108 ⩾ 111 ⩾ 107	109 > 115 ⩾ 411 ⩾ 114 ⩾ XXV ⩾ 113 ⩾ 279 ⩾ Spy ⩾ 108 ⩾ 107 ⩾ 111 ⩾ 110	109 > 115 > 113 > 279 ⩾ 411 ⩾ XXV ⩾ Spy ⩾ 108 ⩾ 110 ⩾ 107 ⩾ 111
114 ⩾ Spy ⩾ 110 ⩾ 108 ⩾ 111 ⩾ 107	115 > XXV > 113 > 279 > Spy ⩾ 108 ⩾ 107 ⩾ 111 ⩾ 110	114 ⩾ XXV ⩾ Spy ⩾ 108 ⩾ 110 ⩾ 107 ⩾ 111
113 ⩾ Spy ⩾ 110 ⩾ 108 ⩾ 111 ⩾ 107	411 ⩾ 108 ⩾ 107 ⩾ 111 ⩾ 110	115 > Spy ⩾ 108 ⩾ 110 ⩾ 107 ⩾ 111
115 ⩾ Spy ⩾ 110 ⩾ 108 ⩾ 111 ⩾ 107	114 ⩾ 108 ⩾ 107 ⩾ 111 ⩾ 110	113 > Spy ⩾ 108 ⩾ 110 ⩾ 107 ⩾ 111
411 ⩾ Spy ⩾ 110 ⩾ 108 ⩾ 111 ⩾ 107	XXV ⩾ 107 ⩾ 111 ⩾ 110	279 > Spy ⩾ 108 ⩾ 110 ⩾ 107 ⩾ 111
279 ⩾ Spy ⩾ 110 ⩾ 108 ⩾ 111 ⩾ 107	113 ⩾ 107 ⩾ 111 ⩾ 110	411 ⩾ 108 ⩾ 110 ⩾ 107 ⩾ 111
XXV ⩾ 110 > 108 ⩾ 111 ⩾ 107	279 > 107 > 111 ⩾ 110	XXV > 110 ⩾ 107 ⩾ 111
Spy > 107		
110 > 107	Spy > 107 > 111 ⩾ 110	Spy > 107 ⩾ 111

Rainfall from Nov. 1 to Feb. 5 was 15·14, 5·66 and 11·54 in. for the three years

The year 1965 was a drought year and mean fruit weight was small—approximately half that recorded in the previous year, when rainfall was about average (30 in. per annum). It was also a year of heavy fruit set. Under these conditions, the ability of a rootstock to maintain fruit size in the scion variety would be adequately tested. The data confirm the earlier finds of Bryden (1948) and Thomas (1953) that trees on Northern Spy have the capacity to produce fruit of large size under stress conditions.

Of the high-yielding trees, those on MM109 produced fruit with the maximum mean fruit weight in all years. Those on Malling 411 and MM114 showed similar fruit size characteristics to trees on Northern Spy. Fruit from trees on MM115, another vigorous rootstock, tended to be smaller.

The low-cropping trees on MM111 maintained their fruit size in the drought year (1965) but showed no significant size increase in better rainfall seasons. Trees on MM110 rootstock appeared to produce small fruit, irrespective of the season.

There were no obvious differences in the colour of the fruit harvested from trees on the several rootstocks.

Habits of several rootstocks.—Contrary to the finding of McKenzie (1964), no suckering occurred in trees on Malling 411 rootstocks at Applethorpe, nor was biennial bearing noticeable. Both MM113 and MM114 rooted very easily in stool beds, though they have been described (Garner 1953) as poor rooters under the stool-bed system. They may, however, "leaf out" late in the season and this could delay grafting for 2 or 3 weeks. MM114 grows very strongly from stool beds and produces many shoots with too large a diameter for lining out in the nursery row. Although Van Heek (1957) reported that trees on MM109 rootstocks in Victoria had a weak roothold, they have remained firmly anchored the Stanthorpe trial.

IV. DISCUSSION

The performance of different rootstocks under a range of soil and climatic conditions is important in commercial practice. Parry (1965) demonstrated that, although yields varied from site to site, the effect of rootstocks on the scion growth was consistent in the United Kingdom. A similar conclusion was reached earlier by Hatton (1930) from data on Malling rootstocks grown on a range of soils.

Parry (1965), however, claimed that apple scions of the Worcester variety interact with particular rootstocks. He found that on average or good sites, MM106 produces a superior tree to Malling VII, whereas on excessively drained light-textured soils and on impeded clays tree size was much the same on both stocks.

The oldest Malling-Merton rootstock trials were reported by Preston (1959). The 13-year-old Cox's Orange Pippin trees on MM109 grown on loam and on sand were similar in size to trees on the very vigorous Malling XVI rootstock but gave higher yields. They were also larger than trees on MM111, but in this case lower in cropping. Parry (1965), with Cox and Worcester scions, showed that in spite of waterlogging, to which both MM109 and MM111 are susceptible, the larger trees were on MM109 rootstock. The three varieties—McIntosh, Cortland and Delicious—used by Longley (1963) were all larger at 5 years of age on MM109 than on MM111.

More important for comparative purposes is the 15-year-old trial of Preston (1962), which included a wide range of stocks with Jonathan as the common scion on an infertile soil. Under these conditions, trees on MM115 and MM109 were larger than those on MM411, MM111, MM107, MM108 and MM110. Further, cropping was heaviest on MM109, followed by MM411, MM115, MM110, MM111, MM108, and MM107 in that order. Preston also showed that the cropping of Jonathan and Ellison trees on MM109 was outstanding in the early as well as the later years of the trial. His results are therefore in agreement with those emerging from the Stanthorpe trial.

A further comparison of the MM rootstocks with Northern Spy was presented by McKenzie (1964), with Jonathan as the scion variety. As at Stanthorpe, trees on MM109 had the largest girths, followed by those on Malling 411, Malling XXV and Northern Spy. The rootstock order for cropping at 8 years was MM411 with the greatest crop, followed by MM109 and Malling XXV; the smallest crop was on Northern Spy.

It would thus appear from the available data that MM109 rootstock confers both vigour and precocity on the scion and has considerable potential value for use in areas where adverse climatic conditions can be expected from time to time.

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