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THE PERFORMANCE OF THE APPLE CULTIVAR DELICIOUS ON MERTON AND OTHER CLONAL ROOTSTOCKS IN SOUTHERN QUEENSLAND

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SUMMARY

Final results are reported on the performance of the Delicious apple on rootstocks Merton 778, Merton 779, Merton 789, Merton 793, Northern Spy, local selection S4, and its own roots planted under wide spaced dryland conditions on two soil types on the Granite Belt, Queensland.

Rootstocks interacted with soil types for trunk girth and yield, and results are discussed from this context.

Largest and smallest tree girths on both soil types were produced by S4 and Northern Spy respectively. Large differences in girth occurred between soil types for all rootstocks except Merton 779. Highest accumulated yields on the more fertile soil type were produced by Merton 778, Merton 793, and Merton 779 in that order. Merton 779 gave highest yields on the poorer soil type. Own roots, Merton 789 and Northern Spy yielded lowest on both soil types.

Two estimates of mean tree fruitfulness showed Northern Spy and Merton 793 were the most fruitful and S4 the least. Northern Spy and Merton 793 may be useful in high density hedgerow, and medium density orchards respectively, where soil fertility is good.

For wide-spaced, dryland management on variable and poor soil conditions, Merton 779 is recommended, while on fertile soil Merton 778 or Merton 793 are recommended for Delicious.

I. INTRODUCTION

Poor and variable soil fertility and structure characterizes apple orchard soils on the Granite Belt of southern Queensland. Considerable soil variations often occur over short distances. Northern Spy, which was the standard district clonal rootstock for Delicious scion because of its resistance to woolly aphid (*Eriosoma lanigerum* Hausm.) and good fruit quality, failed to produce trees large enough to bear an economic crop on some soil types under the existing management practices of wide spacing and dryland farming. Alternative rootstocks were sought (Thomas 1966).

In 1951, a Delicious rootstock trial was field planted at the Granite Belt Horticultural Research Station, Applethorpe. Rootstocks selected for comparison had a wide range of vigour. They were Northern Spy, S4 (a local selection designated Essfour by Thomas, 1966), the Merton rootstocks 778, 779, 789, and 793, and trees on their own roots. All rootstocks except own roots were resistant to woolly aphid. Requirements sought from these rootstocks under these management practices were moderately vigorous to vigorous growth, precocity of bearing, high fruitfulness, high yield performance consistent over variable soil types, and good fruit quality.

An interim report on this trial was published (Thomas 1966), and the main conclusions were—

1. Largest total crops were borne by Merton rootstocks, and the least by Northern Spy.
2. Trunk girth was greatest on S4 and least on Northern Spy.
3. Trees on own roots were less vigorous than on S4, and yielded less than those on Merton rootstocks.
4. Relative order of vigor of trees was similar for varying soil types within the trial.

This paper presents final results following termination of the trial in 1974.

II. MATERIALS AND METHODS

The trial was established under variable soil conditions comprising three soil types, a coarse sandy clay loam, a loamy coarse sand, and a loamy coarse sand overlaying a coarse sandy clay. These soil types are designated hereafter soil types 1, 2, and 3 respectively. Tree spacing was 6·1 m x 6·1 m which is the standard district spacing for dryland management. A randomized block design of 22 replicates of the seven rootstocks with single tree plots was used.

All rootstocks, including own roots, were budded with a selected strain of red Delicious. Granny Smith trees were used as guards and pollinators. Trees were planted as whips and pruned every year to the vase pruning system. Laterals less than 0·3 m were left unpruned to encourage the development of spurs. Larger laterals were pruned back to five buds. Subordinate leaders were developed during the first 5 years to increase the frame of the tree.

Fertilizer practices consisted of an annual spring dressing of 10N:4P:6K mixture applied at 2·7 kg per tree. Minor elements of copper, zinc and boron were applied at locally recommended rates and an intensive pest and disease control program was carried out. Summer weed growth was controlled by cultivation while rye and lupins were grown as winter green manure crops.

Each year, crop yield was measured and trunk girth taken in the dormant season.

By 1965, significant differences between root-stocks for girth and yield had become established, many at the 1% level (Thomas 1966). Thereafter, for management reasons, the replicates were reduced by four to 18, which reduced the number of soil types involved to two, soil 1 and soil 2, with nine replicates on each.

At the completion of the trial, trees on the nine replicates on soil 1 were cut down and scion weights measured. Two estimates of tree fruitfulness were obtained: total accumulated crop per 1974 trunk girth squared for the whole trial, and total accumulated crop per unit scion weight for trees on soil 1.

III. RESULTS

Presented in Table 1 are data on mean 1974 trunk girth; accumulated mean yield per tree 1958–1974 and 1966–1974; and two estimates of mean tree fruitfulness for the seven rootstocks on two soil types. Obvious growth and yield differences were obtained on different soil types, and results are examined from this basis.

TABLE 1

MEAN TRUNK GIRTH 1974 (cm); ACCUMULATED MEAN YIELD PER TREE 1958–1974 AND 1966–1974 (kg); AND 2 MEASURES OF TREE FRUITFULNESS FOR EACH OF 7 ROOTSTOCKS WITH DELICIOUS SCION ON EACH OF 2 SOIL TYPES

Rootstock	1974 Trunk Girth (cm)		Accumulated Yield per tree 1958–1974 (kg)		Accumulated Yield per tree 1966–1974 (kg)		Fruitfulness (a)*		Fruitfulness (b)*
	Soil 1	Soil 2	Soil 1	Soil 2	Soil 1	Soil 2	Soil 1	Soil 2	Soil 1
Merton 779	56·2	51·6	1 568	1 659	1 230	1 216	0·495	0·618	10·65
Merton 778	58·3	46·9	1 683	1 344	1 312	962	0·497	0·609	10·82
S4	67·3	54·8	1 473	1 452	1 176	1 068	0·326	0·482	7·55
Merton 793	51·9	39·8	1 662	1 180	1 216	835	0·617	0·713	14·87
Own Roots	59·3	44·1	1 438	1 119	1 082	796	0·415	0·576	9·78
Merton 789	49·2	39·4	1 400	1 032	982	726	0·569	0·650	16·52
Northern Spy	41·9	31·1	1 316	689	920	498	0·755	0·679	18·46
Grand Mean	54·9	43·9	1 506	1 211	1 113	873	0·525	0·618	12·66
L.S.D. 5%	4·2	5·4	257	324	211	240	0·071	0·075	2·21
1%	5·6	7·2	343	433	282	320	0·094	0·099	2·94

* Fruitfulness (a) = $\frac{\text{1958–1974 accumulated yield (kg)}}{\text{1974 trunk girth squared (cm}^2\text{)}}$

Fruitfulness (b) = $\frac{\text{1958–1974 accumulated yield (kg)}}{\text{1974 scion wt. (kg)}}$

Girth

Mean tree size, as indicated by 1974 trunk girths, differed significantly between rootstocks on both soil types, and follows the pattern indicated in the interim report (Thomas 1966). This is, trees on S4 had the largest girths, those on Northern Spy the smallest, while own rooted trees were of intermediate size. Of the Merton rootstocks, 778 and 779 produced approximately equal maximum tree girths while 793 and 789 produced smaller girths.

Mean trunk girth was on average 20% less for all rootstocks on soil 2 compared with soil 1. However, Merton 779 had only a marginal difference in girth (8%) between the two soil types, while Northern Spy had the largest difference of 26%.

Yield

Mean accumulated yields per tree for the cropping periods 1958–1974 and 1966–1974 differed significantly between rootstocks on both soil types.

For trees on the more fertile soil 1, an obvious yield advantage was conferred by the three Merton rootstocks 778, 793, and 779 over the other rootstocks for the two cropping periods. Merton 789 and Northern Spy yielded significantly less than Merton 778 and Merton 793 for the 1958–1974 cropping period, and significantly less than Merton 778, 793 and 779 for the 1966–1974 cropping period. This confirmed the interim report (Thomas 1966). Precocity of bearing was induced by Merton 793, Merton 789 and Northern Spy (Thomas 1966). However, Merton 789 and Northern Spy lost their early yield advantage due to low yield potential in later years, although Northern Spy produced relatively high yields in some years on this soil type. The very large trees on S4 yielded less than expected on the basis of trunk girth on this soil type and were outyielded, but not significantly, by the considerably smaller trees on Merton 778, 793 and 779. Similarly, Delicious on its own roots yielded less than expected on this soil type.

On the less fertile soil 2, trees on Merton 779 yielded significantly higher than all other rootstocks except S4 and Merton 778 for the 1958–1974 cropping period, and S4 for the 1966–1974 cropping period. Trees on S4 also improved their relative yield performance but again not to the extent expected from trunk girths.

With the exception of Merton 779 and S4, large yield differences occurred between the two soil types for both cropping periods. Trees on Northern Spy exhibited the greatest difference in accumulated yield between soil types of all rootstocks, and a large difference occurred for trees on Merton 793. Merton 793 yielded significantly less than Merton 779 for both cropping periods on soil 2 while yielding higher than Merton 779 on soil 1 for the 1958–1974 cropping period.

The stable yield over the cropping period 1966–1974 of trees on Merton 779 and their ability to maintain approximately equal tree girth on the two distinctly different soil types suggested that these two characteristics were closely related. The greater precocity of Merton 779 on the poorer soil 2 (Thomas 1966) resulted in a higher accumulated yield 1958–1974 than on the soil 1. Below average mean accumulated yields (1958–1974) from the very large trees on S4 on the more fertile soil 1 resulted from their very low precocity on this soil (Thomas 1966) in that only in the last few years of this trial were moderately high yields obtained. The smaller trees on S4 on the less fertile soil 2 yielded above average for both cropping periods.

Fruitfulness

Large significant differences occurred between rootstocks for fruitfulness based on the two estimates, that is, total accumulated crop per 1974 trunk girth squared, and total accumulated crop per scion weight. These differences generally follow the expected pattern; that is, larger trees were less fruitful than smaller trees.

Based on trunk girth estimate, Northern Spy was significantly more fruitful than all other rootstocks on the more fertile soil 1, followed by the less vigorous of the Merton rootstocks 793 and 789. The larger trees on own roots and S4 were the least fruitful.

On the poorer soil 2, Merton 793 exhibited the greatest fruitfulness based on trunk girth, and was significantly more fruitful than Merton 779, 778, own roots and S4. Northern Spy was significantly more fruitful than own roots and S4. S4 was significantly less fruitful than all other rootstocks on this soil type.

Contrary to the general trend, Northern Spy was less fruitful based on trunk girth on the poorer soil 2 than on soil 1. This was related to its exceptionally high fruitfulness of the more fertile soil 1 as well as its extremely low mean yield on the poorer soil 2.

For trees on the more fertile soil 1, fruitfulness based on scion weight followed that based on trunk girth apart from a difference between Merton 793 and Merton 789. This confirms similar findings by Preston (1958) and Thomas (1968) with other scions and rootstocks.

IV. DISCUSSION

Results from this 23-year-old Delicious apple rootstock trial on two distinctly different soil types have confirmed the poor performance of Northern Spy under the management conditions used. Northern Spy produced trees which were very small, precocious in bearing, highly fruitful, and possessed good fruit quality (Thomas 1966), but with a low yield except possibly in a few favourable seasons on the more fertile soil type, and with a large difference in accumulated yield between the two soil types. However, these characters do not preclude Northern Spy from use in high density, well managed, hedgerow orchards on fertile soil.

Merton 789 behaved in a similar manner to Northern Spy except it produced slightly larger and less fruitful trees. Delicious trees on their own roots were large, unfruitful, lacked precocity, and yielded below average on both soil types.

S4 produced the largest and least fruitful trees on both soil types. The approximately equal mean yields from trees on S4 on the two soil types was related to their inability to settle into a mature bearing habit on the more fertile soil 1 until the last few years of the trial while, on soil 2, moderate precocity and above average yields were obtained (Thomas 1966).

The moderately vigorous, highly fruitful trees on Merton 793 were precocious in bearing, especially on soil 1 where they showed a high yield potential, but had a large difference in accumulated yield between the two soil types. The vigour and fruitfulness of Merton 793 suggested that, when planted somewhat closer than the standard 6·1 m square on good soil conditions, yield performance per unit area could be greater than for other rootstocks tested here. This confirms a similar conclusion reached by Richardson (1970), and McKenzie and Hawkins (1971).

Trees on Merton 778 and Merton 779 were moderately vigorous growing, of equal average fruitfulness, and had the highest overall yield but for different reasons. Merton 778 outyielded all other rootstocks on the more fertile soil 1, but yielded considerably less on the poorer soil 2. Merton 779 showed an apparent inherent ability to maintain approximately equal trunk girth and yield from one soil type to another, yielding by far the best of all rootstocks on the poorer soil 2.

High yield performance consistent over a range of soil types is believed to be of greater importance than any other desired rootstock characteristic under this system of management on the Granite Belt. Therefore, it is recommended that Merton 779 be used for Delicious in preference to other high yielding rootstocks.

Generally, for the wide range of tree vigour evidenced in this trial, quite similar relative order of trunk girths existed on both soil types. However, when dealing with rootstocks with a narrow range of vigour such as Merton 778 and Merton 779, relative difference over soil types are evident. It is unlikely that a recommendation other than Merton 779 could have been made had no account of soil variation been taken in this data. However, the potentialities and limitations of all rootstocks tested here are now much more clearly defined.

REFERENCES

McKENZIE, D. W., and HAWKINS, J. E. (1971). Apple rootstock trials IV. Delicious and Sturmer on East Malling and Merton rootstocks in Central Otago, New Zealand. *N.Z. Jl. agric. Res.* 14:481-490.

PRESTON, A. P. (1958). Apple rootstock studies: thirty-five years with Lanes Prince Albert on clonal rootstocks. *J. hort. Sci.* 33:29-38.

RICHARDSON, B. D. (1970). Personal communication.

THOMAS, L. A. (1966). Stock and scion investigations. XIV. Delicious apple on Merton and other clonal rootstocks. *Qd. J. agric. Anim. Sci.* 23:547-554.

THOMAS, L. A. (1968). Stock and scion investigations. XV. Twenty-six year old apple rootstock trial. *Qd. J. agric. Anim. Sci.* 25:211-218.

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