Rootstock Performance in Nova Scotia[1]

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Challenging questions concerning apple rootstocks can be summarized as follows:

1. The fundamental question is not "what is the best rootstock?"; rather, "what density should it be planted"? Once this has been answered, it will be necessary to decide on the proper management system. Once density and management have been determined, then, and only then, can the stocks be selected to fit the cultivars and soils of the proposed orchard.
2. Evaluation of stocks could be simplified if it were known whether or not the ability of the scion variety to utilize incident energy is directly altered by the stock. There is no question that growth patterns —shoot elongation, blossom formation, set, etc., are altered. But, for example, are 'McIntosh' leaves over an 'M.9' stock physiologically acting the same as 'McIntosh' leaves over a seedling stock? Does 'M.9' produce the elusive florigen or is the high rate of blossom induction due primarily to earlier cessation of growth and/or to greater efficiency of the cultivar scion leaves?

Research in Nova Scotia and New Brunswick has taken a good hard look (currently available in mimeograph form) at yield experiences from a number of orchards, at costs and at expected profits. It has been concluded that growers in these provinces should grow a tree with a 12-foot spread, planted 14′ by 20′ — 155 trees per acre. Training, while essential, is minimal and is based on the Dutch slender spindle which eventually evolves into the Crowe scaffold renewal system with some adjustment in degree of detail according to market and variety. Stocks should be selected which give a tree of about 15′ spread with that variety on that particular site. The pruning system will reduce this to the required 12′ spread, allowing 2′ between canopies in the row and 8′ between the rows. Research and extension programs are focused on refining this system. A good balance among high quality, high yields, modest costs, and easy management is expected.

The second thought outlined above requires an about-face from commercial growing to theoretical research. There can be no question that stocks such as 'M.9', 'M.26', and 'MM.106' in-

Table 1. Yield per Increment of Growth* for Three Successive 4-Year Periods, 'McIntosh', on 4 Rootstocks, Block 18

Years from planting in 1958	MM.109	MM.111	MM.104	MM.106	Avg.
3, 4, 5, 6	1.5	2.0	1.2	2.8	1.88
7, 8, 9, 10	14.0	14.2	12.8	15.6	14.15
11, 12, 13, 14	13.0	14.9	12.5	15.0	13.85
		Expressed as percent of average			
3, 4, 5, 6	80	106	64	159	
7, 8, 9, 10	99	100	90	110	
11, 12, 13, 14	94	108	90	108	

*Pounds apples per cm² trunk cross section increase.

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duce precocity in the scion variety. Because of their smaller canopies, the leaves are invariably better exposed to sun and sky light. But suppose the leaves were arranged so that they all had the same exposure and productivity could be measured in the fully mature tree. How would these so-called high producing stocks perform?

Some results of research indicate that, as the trees mature, their performance is somewhat reduced. In Table 1, 'McIntosh' on 'MM.106' in the first four bearing years was 159% of average; while, on 'MM.104', yield per increment of growth was only 64% of average. As the trees matured, there was much less difference, with 'MM.106' trees dropping to only 108% and 'MM.104' rising to 90% of average of the 4 stocks. Somewhat similar changes occurred with the other 2 scion cultivars on these 4 stocks in this orchard. ('MM.111' has performed well with all 3 cultivars and has had very few tree losses.)

This is not to imply, however, that some stocks lose their tendency to channel more of their reserves into fruit relative to growth. In Table 2, the group of stocks included under "8 other MM" ('101', '102', '105', '110', '112', '113', '114', '115') do not show promise as having good yield capacities while the 2 dwarf stocks are rather outstanding.

Table 2. Yield (lbs.) per Increment (cm^2) of Growth for Two Successive 3-Year Periods with Relative Tree Size at 11 Years, 'Red Delicious', on 14 Rootstocks, Block 23

Stocks	Spread (ft.)	Years 6-8	Years 9-11
M.9 and M.26	5.9	11.6	9.6
M.9 and MM.106	11.4	7.4	6.6
MM.109 and MM.111	12.8	7.2	6.9
8 other MM	13.0	4.9	4.3

Data from a trial which is now completing its 41st year show almost identical slopes for the cumulative yield of 'McIntosh' per increment of growth among 4 stocks ('M.2', 'M.12', 'Beautiful Arcade', 'Anis' seedlings) once bearing had become initiated. A fifth stock, 'M.1", may have some advantage over the others. Currently, some of the parameters affecting yield in this experiment are being studied, since its unusually long duration gives a valuable opportunity to examine long term influences of season, cropping, etc., on subsequent tree performance.

All of these results lead to a realization that there is an urgent need for research on the effect of rootstock on the components of yield individually and as a whole. Mathematical approaches through canonical correlation analyses and/or principle component analyses may lead to a better understanding and partial definition of these effects. Eventually, however, considerable skill to design experiments for quantification of the separate components of yield will be necessary. Workers doing research on rootstocks are urged to attempt studies along these lines.

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I certify that the statements made by me above are correct and complete; Loren D. Tukey, Business manager, October 1, 1974.