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Early Production of Apple Cultivars on M.9 and Mark Rootstock

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Abstract

After six years there was little difference in tree size or yield of three apple cultivars on Mark or M.9 rootstocks. Yields of all cultivars in this trial were relatively low and growth was vigorous resulting in large tree size. TCA of both the spur ('Redchief') and standard habit ('Top Red') 'Delicious' strains were larger on Mark than on M.9. 'Melrose' tended to produce larger trees and was more precocious than the other cultivars in this study on M.9. 'Smoothee'/M.9 had equivalent cumulative yield/ha than other cultivars and had the highest production efficiency of all combinations in this study. It is suggested that training techniques to reduce growth and encourage flowering are needed when trees on dwarfing rootstocks are grown on high fertility soils in order to achieve production efficiency.

Introduction

Economic conditions are forcing orchardists to seek means of getting earlier economic returns by planting trees on small precocious rootstocks. The introduction of Mark rootstock by Michigan State University provided a new candidate to compare to M.9 which is the worldwide standard rootstock for producing small precocious trees (2). Early tests in Ohio comparing 'Empire' and 'Golden Delicious' showed that trees on Mark were not as productive or efficient as trees on M.9 and M.26, but were similar in size to trees on these rootstocks (4). Schupp (9) found that trees on Mark resulted in early flowering and improved yields with 'McIntosh' and 'Empire,' but there was little difference with 'Redchief Delicious' or 'Cortland' compared to several other rootstocks. The performance of 'Starkspur Supreme Delicious' on Mark and M.9 was compared over 27 sites in the United States and Canada and there was no difference in tree size or cumulative yield or tree efficiency over 10 years (8).

Fruit production in Ohio is normally on clay and silt loam soils, which result in relatively large tree size. It is clear from past studies that spacing must be correct for intensive plantings to achieve long-term efficiency (3, 6). In order to evaluate early performance in an intensive planting several cultivars on M.9 and Mark were planted as guard trees in an orchard systems trial. A secondary objective was to evaluate the performance of several cultivars in a minimally trained slender spindle system.

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Materials and Methods

In the early May of 1987 trees of each combination shown in Table 1 were planted at a spacing of 2 m x 4 m in a fine, loamy mixed mesic typic fragiudalf soil. The trees were planted as guard trees on the ends of rows of trees trained as slender spindles with each tree supported by a post (1.8 m protruding above ground). The trees received minimal pruning and were generally trained as slender spindles with leader replacement, although bending was not used to position limbs. Ten to 12 trees of each combination were planted in groups of 2-3 trees at random on the ends of two rows of slender spindle trees arranged as a completely random design with 5 replications. The trees received standard herbicide and pesticide treatments and an application of ammonium nitratet based on an annual increase up to 225g at age 4 and maintained at that level in latter years.

Trunk area and yield were measured annually and following the sixth growing season, tree height and spread were measured prior to removal of the trees.

Results and Discussion

Trees of both the spur type and standard strains of 'Delicious' were larger on Mark than on M.9, while trunk area of 'Jonathan' did not differ between the rootstocks (Table 1). Calculation of tree volume using the formula for a cone which is generally appropriate for slender spindle trees follows the same pattern as the other measurements with no significant difference between the 2 rootstocks for any cultivar. All trees exceeded their 2 m allotted spacing except 'Redchief Delicious'/M.9. Trees of 'Melrose' and 'Topred Delicious' were especially large and obviously not well adapted to the 2 m x 4 m spacing without using additional size controlling training techniques. Trees of 'Empire,' 'Smoothee' and 'Jonathan' could be managed at this spacing. Although the differences were not significant statistically between Mark and M.9, trees on Mark generally appeared slightly larger than trees on M.9 and this should be taken into account in a closely planted intensive system like slender spindle. This slight increase in tree size could be particularly important for cultivars that naturally produce vigorous growth and large tree size.

A small yield of fruit occurred in 1989 mostly on 'Smoothee' and 'Empire.' The first significant crop occurred in 1990 with the highest yields on 'Jonathan'/Mark and 'Melrose'/M.9 (Table 1). 'Topred Delicious' had very low yields on both rootstocks in 1990. Yields in 1991 and 1992 were relatively low and did not differ greatly among cultivars. A statistical comparison between rootstocks indicated that in 1990 trees on Mark had larger trunk areas than trees on M.9 and in 1991 trees on Mark had higher yields, mostly due to the high yields of 'Redchief' on Mark, compared to trees on M.9. The overall measurements of tree size in 1992 and cumulative yields did not differ according to contrast analysis between rootstocks.

Trunk area of 'Red Chief Delicious' on Mark in this trial was nearly 3.5 times and cumulative yield 2.4 times larger than similar aged trees in Maine (9). Although different standard habit 'Delicious' strains were used, trunk area and yields were similar for trees in this study and a report from Washington (1). These trials (1, 8) did not directly compare Mark and M.9.

Although 'Smoothee' was one of the higher yielding cultivars in this trial through the sixth year, the yield was 49% lower than the yield of 'Smoothee' trained as a slender spindle in a comparable period in a previous Ohio trial (6). Yield of the 'Delicious' strains were also lower than previously reported (5), although the strains in the two studies differed. The lower yields in this study may be partially due to

Table 1. Early performance of several apple cultivars trained as slender spindles on M.9 and Mark rootstocks planted in 1987.

Cultivar	Rootstock	Tree size 1992				Yield (kg/tree)			Cumulative yield	Cumulative efficiency
		Trunk area (cm^2)	Tree height (m)	Tree spread (m)	Tree volume (m^3)	1990	1991	1992	kg/tree	kg/cm^2
Jonathan	Mark	31.8bc*	2.6bc	2.6ab	4.6cd	9.8a	8.8abcd	6.5c	25.1ab	.70b
Redchief Delicious	Mark	28.9bc	2.9cd	2.3b	3.1de	4.9cde	12.7ab	5.4c	23.0abc	.64b
Topred Delicious	Mark	41.5a	2.9ab	3.1a	7.5a	2.5f	3.5d	16.1a	22.1ab	.47b
Jonathan	M.9	26.8cd	2.4cd	2.3b	3.5de	8.3b	6.5cd	5.9c	20.7bc	.62b
Redchief Delicious	M.9	18.0d	2.1d	1.7c	1.9e	4.0cdef	6.6cd	2.1c	12.7c	.48b
Topred Delicious	M.9	28.7bc	2.9ab	2.8ab	6.3abc	1.8f	6.9bcd	4.8c	13.5bc	.53b
Melrose	M.9	37.0ab	3.2a	2.6ab	6.8ab	9.8a	11.9abc	9.9abc	31.6a	.64b
Lawspur	M.9	31.6bc	2.8bc	2.8ab	5.1bcd	8.1b	9.5abc	7.6c	25.2bc	.69b
Smoothee	M.9	24.9cd	2.6bc	2.4b	4.4cd	5.2cd	11.2abc	14.7ab	31.1a	1.21a
Empire	M.9	26.8cd	2.2d	2.5b	3.9de	5.5c	13.4a	6.2c	25.1ab	.78b

*Mean separation within columns by Duncan's Multiple Range Test, 5% level.

the lack of bending and tying limbs down, which is a recommended practice with slender spindle training. Training techniques that decrease growth and increase fruiting may be particularly important when trees are grown on soils that produce vigorous growth and large tree size. Other studies (6, 7) have shown that correct spacing and early production are critical to the economic and production efficiency of intensive orchard systems. Andrews and Rom (1) also "recommended that trees on Mark rootstock be supported and that careful crop management of precocious scion cultivars be observed in the early years of the planting."

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Fruit Count—Sink Strength

A curvilinear relationship between yield and fruit count per tree on 9 rootstocks over 9 years suggests that sink strength of an apple crop is nearly proportional to the number of fruit per tree. See Elfving and Schechter 1993, Hort. Sience:793-795.