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Apple Cultivar Performance on M.26 in Southern Ohio

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Abstract

In 1969 a planting of 18 cultivars on M.26 rootstock were established in southern Ohio at two spacings. 'Early Red Stayman' made very weak growth and had the smallest trunk cross-sectional area which reflected partial incompatibility of this cultivar and M.26. Standard habit 'Delicious' strains and vigorous cultivars such as 'Spartan,' 'Mutsu,' 'Lodi,' 'Spijon,' and 'Chieftain' produced excessive vegetative growth in response to containment pruning and were not adapted to the 8 or 10 foot spacings used in this trial. 'Golden Delicious' had the highest accumulated yield per tree and ranked third in productive efficiency during the 10 years of this study. Trees of all cultivars planted at the wide spacing (10′ x 16′) were significantly larger and more productive than those planted at the closer spacing (8′ x 16′).

Introduction

Since most of Ohio's apple crop is sold for fresh consumption, either through direct grower marketing channels, such as U-pick and farm markets, or indirectly through grocery chainstores, new cultivars with high quality are continually being sought. Since many Ohio growers rely on retired people and consumers to pick their crop, roostocks such as M.26 that will produce smaller trees, need to be evaluated. Trees that can be handled from the ground are ideal for U-pick operations and also increase orchard efficiency through closer planting and significant production earlier in the life of the planting. A complicating factor in establishing reliable cultivar and rootstock recommendations for Ohio is the influence of different climatic regions within the state on cultivar performance. Annual low temperatures along the Lake Erie shoreline and several areas along the Ohio river are up to 20°F higher than similar annual lows in northern Ohio (9). The growing season in southern Ohio can be 160-170 days compared to 145-155 days in central or northern Ohio. Apple bloom in most years is 2 to 3 weeks earlier in southern Ohio compared to the northern border. This report summarizes the performance of 18 cultivars on the dwarfing rootstock M.26 in the warmer southern area of Ohio.

Materials and Methods

A planting was established in 1969 at the Southern Branch of the Ohio Agricultural Research and Development Center at Ripley, Ohio. Some of the trees in this planting were purchased from nurseries, others were bench-grafted and planted directly or budded on rootstocks planted in place. In assessing the planting in 1971, although tree stand was good, there was great variability in tree size. A decision was made to cut all trees back to 16 inches and train the new growth as a single shoot. The trees were in north-south rows with 4 eastern rows planted 10′ x 16′ and the 4 western rows planted 8′ x 16′. The trees in two rows of each spacing were supported by a 4-wire trellis with the top wire at a height of 6′ and the alternate rows were supported by a 3 inch diameter, 7 foot treated stake driven in the soil, 10 inches from the tree. The 18 cultivars on M26 in the planting were completely randomized with a range of 4-19 trees of each cultivar for a total of 252 trees. The trees on the trellis were trained as oblique palmettes and those supported by stakes trained as central leaders using limb spreaders. The trees were

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Table 1. Tree size, yield and yield efficiency of 18 apple cultivars on M.26.

Rootstock	Number of trees	Spread			Balance of Fruiting Vegetative Growth*			Trunk** Area (cm^2)	Accumulated	
		Across row (m)	In row (m)	Height (m)	Bottom half	Top half	B/T		Yield lbs/tree	Yield Efficiency lbs/cm^2
Gallia Beauty	9	3.17	3.15	3.11	5.0	4.4	1.2	98.6bc	858.6bc	9.3bcd
Golden Delicious	14	3.60	3.50	3.14	4.6	4.6	.9	142.1b	1495.2a	10.8ab
Melrose	8	3.45	3.50	3.18	4.4	4.0	1.1	137.8bc	797.8bcd	6.1de
Ruby	11	3.10	2.96	2.87	4.6	3.7	1.3	84.8bc	886.0bc	13.5a
Double Red Jonathan	14	3.42	3.56	3.06	4.7	5.3	1.0	148.3b	774.7bcd	5.5e
Holiday	7	3.49	2.99	2.58	4.4	4.5	1.1	106.1bc	512.7d	5.9de
Hi Early Delicious	8	3.79	3.41	3.36	4.8	6.4	.8	130.2bc	919.5bc	7.1cde
Red King Delicious	13	3.58	3.54	3.19	4.7	6.1	.9	123.4bc	728.5bcd	7.3cde
Red Prince Delicious	14	4.02	3.68	3.50	4.9	7.2	.7	149.9b	740.9bcd	5.5ef
Royal Red Delicious	8	3.34	3.50	3.46	4.8	5.1	1.1	100.3bc	725.7bcd	7.3cde
Spartan	19	3.72	3.80	3.47	5.0	6.6	.8	144.2b	792.3bcd	5.9de
Sundale	14	3.63	3.33	2.98	4.6	5.1	1.0	91.1bc	752.6bcd	9.2bcd
Jonagold	13	3.21	3.09	2.87	4.3	4.1	1.3	90.4bc	591.9cd	7.9cde
Early Red Stayman	8	2.79	2.80	2.67	3.7	3.2	1.2	72.7c	714.3bcd	10.8abc
Mutsu	12	3.81	3.94	3.75	5.2	6.2	.9	232.0a	927.5b	6.3de
Lodi	14	3.50	3.86	3.58	4.8	5.9	.8	163.2b	777.4bcd	5.3e
Spijon	9	3.85	3.80	3.18	4.5	6.3	.7	154.7b	706.7bcd	5.5e
Chieftain	17	3.75	3.79	3.36	4.4	5.7	.8	168.5	803.1bc	4.9e
Lsd .05		.38	.48	.39	.5	1.3	.3			

*Rating system: 1-10 of balance of fruiting to vegetative growth with value of 5 the optimim and below 5 not enough shoot growth and above 5 too much shoot growth.
**Mean separation by Duncan's Multiple Range Test 5% level.

maintained with herbicide strips and mowed sod middles with standard insect and disease control procedures. Yield/tree and trunk circumference were taken annually and in 1981 tree height and spread were determined. In addition, each tree was visually divided into top and bottom halves and each rated for the balance of fruiting and vegetative growth in 1981. A value of 1 was given when no vegetative growth was evident and only spur growth existed to a 5 for good balance of vegetative and reproductive growth and a value of 10 when excessive vegetative growth and very little fruiting wood.

In 1978, it became apparent that some containment pruning was necessary for vigorous cultivars such as standard 'Delicious' on M.26 on this soil. In order to determine if summer pruning could be used to advantage, it was imposed across the 'Delicious' strains so 20 trees were summer pruned and 20 trees were not. Summer pruning was accomplished in early August in 1978, 1979 and 1980 by removing tall uprights and cutting protruding laterals back to a fruit or lateral on 3-year-old wood. This normally involved 12-24 cuts/tree. All trees received a normal thinning out dormant pruning. In addition to yield and a color rating of a whole box, a 20-fruit sample was collected and the following parameters determined in 1979 and 1980: individual fruit color, firmness, soluble solids, and cork spot. It is recognized that the interaction of 'Delicious' strain, training system and summer pruning cannot be defined from this limited test, but the gross effects of summer pruning on fruit quality and the differences among strains on some of these quality attributes can be assessed.

Results & Discussion

The trees grew vigorously on this site and even though nitrogenous fertilizer was withheld in later years, most cultivars exceeded their allotted space, either at the 8 feet (2.46 m) or 10 feet (3.07 m) spacing (Table 1). Although attempts were made annually to control tree height beginning in 1977, it was obvious that cultivars such as standard habit 'Delicious,' 'Spartan,' 'Mutsu,' 'Lodi,' and 'Chieftain' exceeded 11 feet (3.3m) in height. These cultivars required ladders to pick part of the crop, while 'Ruby,' 'Holiday,' or 'Early Red Stayman' could be harvested and pruned from the ground. Just prior to pulling the trees, an attempt was made to rate the cultivars to

Table 2. Influence of two tree spacings and two support systems on tree size and yield of apple cultivars on M.26.

	Across row (m)	In Row (m)	Height (m)	Balance of Fruiting/ Vegetative Growth** Bottom half	Top half	B/T	Trunk Cross-sectional area (cm²)	Accumulated Yield lbs/T	Accumulated Yield Efficiency lbs/cm²
Spacing									
10′ × 16′	3.64a	3.6a	3.46a	4.8a	5.6a	.96a	144.1a	881.4a	7.30a
8′ × 16′	3.46b	3.34b	2.43b	4.6a	5.3a	.99a	114.7b	675.4b	7.23a
System									
Staked	3.68a	3.95a	3.24a	4.6a	5.4a	.96a	135.5a	847.3a	7.42a
Trellis	3.42b	3.05b	3.16a	4.7a	5.5a	.99a	123.4a	709.5b	7.01a
Interaction Comparison									
Sp × Sys	NS	NS	*	NS	NS	NS	NS	NS	NS
Sp × Cv	NS	NS	NS	NS	NS	NS	*	*	NS
Sys × Cv	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Interaction significant at 5% level.
**Rating system: 1-10 of balance of fruiting to vegatative growth with value of 5 the optimum and below 5 not enough shoot growth and above 5 too much shoot growth.

Table 3. Trunk cross-sectional area and accumulated yield/tree of 18 cultivars on M.26 planted at spacings of 8′ × 16′ of 10′ × 16′.

Cultivar	No. Trees		Trunk Cross-sectional area (cm)		% differences	Accumulated Yield/ tree (lbs/tree)		% differences
	8×16	10×16	8×16	10×16	from 10×16	8×16	10×16	from 10×16
Gallia Beauty	4	5	63.0	126.6	51	692	974	29
Golden Delicious	7	7	132.9	151.6	13	1279	1715	26
Melrose	1	6	96.2	139.8	31	339	853	61
Ruby	5	6	89.6	81.7	- 9	700	1095	37
Double Red Jonathan	7	7	164.0	143.1	-13	805	810	1
Holiday	3	5	59.2	133.8	56	478	527	10
Hi Early Delicious	2	5	121.0	133.9	10	696	1003	31
Red King Delicious	6	5	129.3	107.4	-17	659	730	10
Red Prince Delicious	7	7	113.4	183.3	48	610	855	29
Royal Red Delicious	4	5	99.3	94.9	- 5	690	726	5
Spartan	12	7	149.0	133.8	-11	725	915	21
Sundale	7	6	91.0	106.2	15	767	866	12
Jonagold	10	3	96.1	74.7	-23	580	625	8
Early Red Stayman	3	5	84.7	65.7	-23	729	699	- 5
Mutsu	7	5	231.1	233.0	1	858	1030	17
Lodi	8	6	153.8	186.8	18	705	885	21
Spijon	5	5	77.0	231.9	33	402	1016	61
Chieftain	9	6	158.5	189.3	17	712	1002	29

see how they had responded to several years of containment pruning. Most cultivars had a desirable balance of vegetative extension growth to fruiting spurs in the lower half of the tree. 'Early Red Stayman' was an exception showing very weak growth consisting almost entirely of spurs with very little shoot growth for renewal wood in the lower half of the tree. It also had the smallest trunk cross-sectional area of all cultivars in this trial. Previous work in Ohio (2, 6) has shown that 'Blaxtayman' performed poorly on M.26 and is partially incompatible on this rootstock. Evidence in both poor yield and growth responses with 'Early Red Stayman' in this planting would indicate that both these strains of 'Stayman' have similar problems on M.26.

The standard habit strain of 'Delicious,' particularly 'Red Prince' and vigorous cultivars such as 'Spartan,' 'Mutsu,' 'Lodi,' 'Spijon,' and 'Chieftain' reacted negatively to the containment pruning as demonstrated by a high rating in the top half of the tree (Table 1). These cultivars produced an excessive amount of vegetative shoot growth in response to the pruning and would be problem cultivars to contain at the spacings used in this study.

'Golden Delicious' had the highest accumulated yield per tree and ranked third in productive efficiency during the 10 years of this study (Table 1). The combination of 'Golden Delicious' on M.26 has performed well in other Ohio studies (1, 2, 7) and is a desirable combination for commercial plantings. 'Holiday' had a relatively small tree size and the lowest accumulated yield of all cultivars in this trial and another trial on this farm (5). Although the fruit quality of 'Holiday' is outstanding, a premium price would be necessary to compensate for its low productivity. 'Lodi,' 'Spijon,' and 'Chieftain' were very large, vigorous trees on M.26 and had very low productive efficiency as judged by the amount of fruit produced for the wood grown. 'Sundale' is a spur type 'Golden Delicious' and was not as productive or as efficient as standard 'Golden Delicious,' which supports previously published work (7). Spur type 'Golden Delicious' would not be recommended.

Generally, trees of all cultivars planted at the wider spacing (10′ x 16′) were significantly larger and more productive than those planted at the closer spacing (8′ x 16′). Spacing or system of support had no influence on the balance of fruiting to vegetative growth or yield efficiency (Table 2). The method of support demonstrated that training the branches to the trellis resulted in a smaller tree that was less productive than the larger central leader trees supported by a stake. This result differs from previous work that demonstrated greater efficiency for trellis trained trees (3, 4). In the studies demonstrating greater productive efficiency for trellis training, tree spacing was adjusted to the training system and in this trial no adjustment was made and the rows for the trellis could have been slightly closer together. Previous studies also compared M.9 rootstock and not the more vigorous M.26 that was evaluated in this trial. In evaluating the potential interactions between spacing, cultivar and system of support most were not significant. Support system showed no significant interaction with either spacing or cultivar in this study.

There was a significant interaction of spacing and cultivar for trunk cross-sectional area and accumulated yield/tree (Table 3). While trees of most cultivars were larger at the wider spacing which would be expected, the following cultivars were smaller: 'Ruby,' 'Double Red Jonathan,' 'Red King Delicious,' 'Spartan,' 'Jonagold,' and 'Early Red Stayman.' There is no obvious explanation for this, however, a number of these cultivars had high productive efficiency which may have resulted in smaller tree size. Another possibility is that at the wider spacing, less containment pruning was necessary and thus, localized growth promotion was minimized. This is unlikely, however, because 'Red King' and 'Spartan' certainly exceeded their allotted space. Generally, yield per tree was highest at the widest spacing (10′ x 16′), but there was a wide divergence from -5% to 61% among cultivars. Wide spacing was most beneficial to 'Melrose' and 'Spijon,' which are vigorous cultivars and 'Ruby' which is a relatively small tree, but very productive.

Since containment pruning was necessary in this block, it seemed desirable to evaluate summer pruning as a potential technique to achieve tree size reduction. Due to the complexity of this study the interaction of 'Delicious' strains, training system, spacing and summer pruning cannot be defined from this limited test. However, the gross effects of summer pruning on fruit quality and yield, as well as the difference among 'Delicious' strains can be evaluated. Three years of pruning in August resulted in a reduction in soluble solids and an increase in firmness, but had no effect on the other parameters measured (Table 4). Although the 'Delicious' strains differed in fruit color, summer pruning had no influence on the color of these high coloring strains. Similar results have been reported previously for the effects of summer pruning on fruit quality (10). The relative ranking of the 'Delicious' strains varied from year to year on yield and color characteristics. Firmness and soluble solids did not differ significantly among strains. Generally, summer pruning opened up the rows and allowed easier access to the trees at harvest and less potential bruising due to equipment. There was no evidence from this study or other work (8) that summer pruning was more dwarfing than equivalent dormant pruning.

Tree loss over 10 years in this trial was 9%, which was similar to some reports (2) and much lower than the loss reported in previous long-term studies on M.26 (1, 6, 7). Tree losses were greatest for 'Early Red Stayman' (28%), 'Jonagold' (24%), and 'Holiday' (22%). Similar significant tree losses occurred with 'Blaxtayman' and 'Holiday' in a previous study (1) and were considered to be due to partial incompatibility.

Table 4. Yield and fruit quality characteristics of selected standard habit Delicious strains on M.26 and the influence of summer pruning.

Delicious strain	No. of trees	1978 Yield lbs/t	1978 Yield efficiency lbs/cm	1979 Yield lbs/t	1979 Yield efficiency lbs/cm	1979 Color Rating* fruit	1979 Color Rating* crate	1979 Cork** spot	1979 Firmness (kg)	1979 SS (%)	1980 Yield lbs/t	1980 Yield efficiency lbs/cm	1980 Color Rating fruit	1980 Color Rating crate	1980 Cork spot	1980 Firmness (kg)	1980 SS (%)
Triple Red	3	151	2.2ab	129	1.4	1.2c	8.6a	1.1b	5.0	15.5	117c	1.4ab	1.9d	8.3a	.5	5.5	13.9
Hi Early	6	245	2.5a	157	1.2	1.4c	7.1ab	1.3b	5.8	14.1	226a	1.6a	2.6b	7.3ab	.5	6.0	13.1
Red King	9	233	2.2ab	131	.9	2.8a	4.7c	1.4b	5.5	14.1	188ab	1.3ab	3.5a	5.2c	.6	6.1	13.2
Red Prince	10	218	1.7b	120	.8	1.9b	6.0b	1.5ab	5.6	13.4	172bc	1.9c	2.9b	6.9b	.8	6.1	12.9
Royal Red	5	204	2.6a	90	.9	1.6bc	6.4b	1.7ab	6.0	14.7	132c	1.2bc	2.4cd	7.4ab	.8	6.4	13.3
Chelan Red	3	216	2.3ab	98	.9	1.2c	8.3a	1.3b	5.5	14.0	186abc	1.5ab	1.7d	7.6ab	.5	6.2	13.1
Topred	4	184	2.1ab	106	1.0	1.8bc	7.3ab	1.9a	5.6	13.6	153bc	1.2abc	2.0cd	8.0ab	.6	6.2	13.0
Check	20	206	2.2	128	1.1	1.8	6.6	1.4	5.4b	14.4a	176	1.3	2.6	6.8	.7	5.9b	13.5a
Summer Prnd	20	224	2.0	117	.8	1.9	6.2	1.5	5.7a	13.5b	171	1.2	2.7	7.0	.6	6.3a	12.7b

*Fruit color rating: 1 = 100% red to = 50% red; Crate Rating: 1 = poor color to 10 = 100% red.
**Cork spot: 0 = no cork spot to 5 = severe cork spot.

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