Performance of Six Cultivars on M26[1]

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In an evaluation of various orchard design alternatives for greatest efficiency, Cain (1) suggested that maximum efficiency in a hedgerow orchard would be achieved by trees with a spread of 10 feet and a maximum height of 12 feet. Various researchers (2, 4, 6, 8) have reported that the rootstock that comes closest to producing trees this size is M26. In addition, M26 had been found cold hardy (9), to have greater production efficiency than several larger rootstocks (2, 6), and produce large fruit size (7). In order to more fully evaluate the potential and productive efficiency of M26, a planting was established in 1968 at the Ohio Agricultural Research and Development Center at Wooster, Ohio.

Materials and Methods

The planting was set 12′ x 20′ and consisted of the following 6 cultivars: Blaxtayman, Gallia Beauty, Golden Delicious, Jonathan, Melrose and Red Prince Delicious. Originally the trees were trained to a central leader. However, in 1971 a series of pruning and training treatments were imposed to contain all trees to a height of 10′ and a spread of 12′. The interaction between cultivar and pruning treatment was not significant in any year of the study and only the cultivar responses are included in this report. The cultivars were arranged as a randomized complete block with 6 replications and 9 trees of each cultivar in each replication for a total of 324 trees. In 1973, Melrose and Red Prince Delicious were scored 2 weeks following bloom to encourage flowering. The trees were chemically thinned when necessary with all trees of a cultivar receiving the same application. The trees were fertilized according to need indicated by leaf analysis, and standard herbicide and pesticide programs were applied.

Tree height, spread, trunk circumference and pruning time were recorded annually. The entire yield from each tree was graded each year on an FMC weight-sizer and the number of fruit in each of the following size classes was recorded: Size 1, 3⅛″ diameter and larger; Size 2, 2⅞-3$\frac{1}{16}$″; Size 3, 2$\frac{5}{16}$-2¾″; Size 4, 2¼″ and smaller. The fruit were graded according to commercial standards and culled fruit removed and counted. A 40 apple sample of culled fruit was taken from each tree and evaluated for the primary cull factor in 1975. The dollar value of the accumulated fruit from each tree was calculated each year using the following values for the various sizes and grades obtained from a commercial packer in 1972: Size 1 = 13.2¢/lb; Size 2 = 12.6¢/lb; Size 3 = 10.2¢/lb; Size 4 and culls = 3.6¢/lb. The same values were used for all cultivars and years to assess the relative differences among cultivars.

Results and Discussion

Little difficulty was encountered in maintaining a central leader in Golden Delicious and Blaxtayman. The willowy nature of the wood of Jonathan and Gallia Beauty coupled with the tendency of terminal fruiting in the latter required special fruit thinning and heading pruning cuts to maintain the central leader. The cultivars ranked in the following order in the average number of spreaders

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required/tree: Gallia Beauty (6.1), Red Prince Delicious (5.4), Golden Delicious (4.6), Melrose (3.3), Blaxtayman (2.8), Jonathan (2.1). The naturally wide crotch angles of Jonathan and Blaxtayman made the use of spreaders questionable with these cultivars. In the other cultivars, spreaders are generally necessary to establish the dominance of the central leader. Red Prince and Melrose grew vigorously and the reduction in growth and promotion of flowering due to limb spreading was very desirable with these cultivars.

Melrose, Golden Delicious and Red Prince Delicious had exceeded their allotted 10′ in height in 1973 at age 6 and in 1974 the 10′ in-row spread was reached. In subsequent years, containment pruning was necessary on these cultivars and after 8 years of growth (1976) all cultivars had filled or overgrown their allotted space (Table 1). Only Gallia Beauty and Jonathan could easily be contained at the 12′ x 20′ spacing on the deep fertile Canfield silt loam soil on this site. The other cultivars were a continuous hedgerow with slight overlap of branch tips between trees.

Trees were variable in tree size, had sparse foliage and branch formation and developed an excessive overgrowth at the bud union. These indications and experience of this combination breaking at the union in other plantings (5) would suggest incompatability between Blaxtayman and M26. This condition would partially explain the low pruning time required for this cultivar (Table 1). Gallia Beauty required less pruning time than the other cultivars due to its terminal bearing characteristics and limited branching habit. Melrose and Red Prince Delicious grew very vigorously and required significantly more containment pruning than the other cultivars. These cultivars required larger thinning cut particularly on the tree periphery to keep the trees contained. Golden Delicious and Jonathan required more detailed thinning cuts throughout the tree. Although very different types of pruning were required to maintain uniform canopy densities, the total accumulated pruning time from 1972-1976 was not different for Golden Delicious, Jonathan, Melrose or Red Prince Delicious.

Red Prince Delicious had the lowest accumulated yield per tree, value of fruit/tree (Table 2), and production efficiency (Table 1) as measured by the ratio of yield to trunk cross sectional area. Although Red Prince Delicious had a greater percentage of

Table 1. Tree growth, pruning time, production efficiency in 1976, and primary cullage factors of 6 apple cultivars on M26 planted in 1968 at a spacing of 12′ x 20′.

Cultivar	Trunk circ. (cm)	Tree heighth (ft)	Tree spread (ft)	Accum. prun. time sec/t	Prod. efficiency[b] lbs/cm²	1975 Primary Cullage Factors (%)					
						Bruise	Russet	Color	Disease	Insect	Other
Blaxtayman	32.4c[a]	11.9b	12.1bc	473c	13.4c	8	1d	22a	20d	6	43a
Gallia Beauty	30.5c	11.4c	11.5d	682b	13.6c	7	5cd	23a	57b	4	4c
Golden Delicious	35.1ab	12.9b	12.3bc	935a	16.8b	8	61a	7bc	16d	1	7c
Jonathan	31.4c	10.4d	11.9c	874a	10.3a	8	31b	12b	7e	6	36a
Melrose	36.1a	12.9a	12.5b	965a	11.8d	14	9c	27a	32c	1	17b
Red Prince	34.1b	12.6a	13.2a	850a	8.6e	6	1d	3c	76a	1	13b
						NS				NS	

[a]Mean separation within columns by Duncan's multiple range, 5% level.
[b]Production efficiency = accumulated yield ÷ trunk cross sectional area.

large apples and lower percentage of small and cull fruits than Golden Delicious, the Delicious price would need to be nearly double that of Golden Delicious to be of equal dollar value per tree. In a 10 year evaluation of standard habit Delicious strains, Red Prince ranked 7 out of 13 in accumulated yield (3), thus, this strain adequately reflects the productive potential of standard habit Delicious in Ohio. Golden Delicious had the highest accumulated yield and average fruit value per tree, but production efficiency was lower than Jonathan which ranked second in yield per tree.

Bruising, russet and poor color were the most important reasons for culling fruit in most years of the study. In 1975 a rather severe outbreak of apple scab resulted in significant cullage of all cultivars except Jonathan (Table 1). A high percentage of the culls of Golden Delicious and Jonathan were due to excessive russet and in some years Melrose also fell into this category. Gallia Beauty, Blaxtayman and Melrose had more fruit culled due to inadequate color than the other cultivars. Severe cracking was the primary cullage factor for Blaxtayman and Jonathan spot resulted in significant cullage of Jonathan in some years.

Gallia Beauty had the largest fruit of the cultivars in this study with an average of 69% larger than 3⅛" diameter (Size 1) over 5 years (Table 2). Although Jonathan had the smallest percent of Size I fruit, it had the highest percent in the Size 2 class. Golden Delicious and Jonathan produced the most bagging size (Size 3) apples and Gallia Beauty and Melrose the fewest. Jonathan and Melrose had a similar number of fruit per tree, but Jonathan had a much higher accumulated yield per tree due to its early crops when Melrose produced very little. However, the larger fruit size and heavy yields in late years resulted in Melrose having a higher average yield per tree than Jonathan. Gallia Beauty and Red Prince Delicious had similar number of fruit per tree, but due to the early cropping and large fruit size, Gallia Beauty had a higher accumulated and average yield/tree than Red Prince Delicious.

Melrose and Red Prince were 1 year later in coming into bearing than the other cultivars in this study (Table 3), but after bearing began, Melrose consistently out-produced Red Prince. The consistency of production of Mel-

Table 2. Fruit size distribution and average number of fruit, value and yield per tree (1972-1976) of 6 cultivars on M26 planted in 1968, 12′ x 20′, Wooster, Ohio.

Cultivar	Average 1972-1976 % Fruit Size Distribution[b] 1	2	3	4	Culls	Average $ value tree/yr	Average No. of fruit/tree/yr	Accu. yield/tree (lbs)	Average yield/tree (lbs)
Blaxtayman	49.9b[a]	13.0c	19.8c	2.9b	14.4c	7.88c	229c	1062d	130b
Gallia Beauty	69.0a	9.0e	5.0e	2.6b	14.4c	8.00c	181d	999e	136b
Golden Delicious	32.2c	15.0b	30.5a	2.5b	19.8b	11.01a	350a	1574a	138a
Jonathan	18.3d	35.4a	26.7b	5.0b	14.6c	9.76b	287b	1500b	143b
Melrose	48.9b	10.1cd	6.8e	2.4b	31.8a	9.91b	267b	1198c	174a
Red Prince	50.0b	11.6cd	11.1d	6.2a	10.9d	5.78d	167d	762f	96c

[a]Means separation within columns by Duncan's multiple range, 5% level.
[b]Size 1 = 3⅛" and larger; Size 2 = 2⅞"-3 1/16"; Size 3 = 2 5/6"-2¾"; Size 4 = 2¼" and smaller diameter.

rose is noteworthy when compared to other cultivars. In 1975, Golden Delicious produced 908 bushels/acre, was chemically thinned and appeared to have a full but not excessive crop. The other cultivars had good crops but none appeared excessive. But, in 1976 Melrose returned with a crop only 18% smaller while crops on the other cultivars were approximately half the 1975 crop. Blaxtayman had almost no bloom or fruit following a modest crop of 574 bu/a.

This consistency of Melrose was also found in another study of several cultivars on M7 planted in 1964 at a spacing of 22.5′ x 25′, the yield/tree of Melrose fluctuated (Fig. 1), but the fluctuation was at a higher yield level than other cultivars. In both studies, low years of production during the period 1973-1978, the yield of Melrose was similar to the high yields of Jonathan, Golden Delicious and Red Prince. The ability of Melrose to have significant production in years of generally low yields is one of the characteristics that make this cultivar desirable for farm market sales where consistency of production is necessary to retain repeat customers.

The relative productiveness and precocity of these 6 cultivars on M26 was similar to that observed on other rootstocks. Thus, a number of rootstocks could serve to test cultivar performance as long as incompatibility problems (e.g. Blaxtayman) are avoided. Tree losses on M26 in this planting were 7% but in other test plantings in Ohio tree losses reached 42% due to intolerance of this rootstock to wet soil conditions and fireblight.

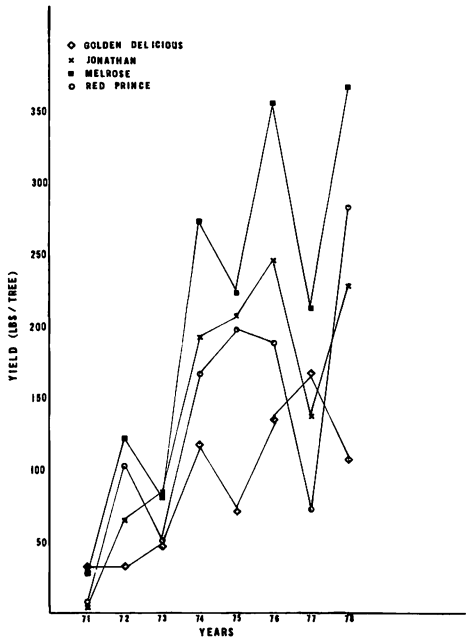

Fig. 1. Performance of 4 cultivars on M7 planted in 1964 at a spacing of 22.5′ x 25′ at the Mahoning County Branch.

Table 3. Yield efficiency of 6 cultivars on M26 planted at 12′ x 20′ during their 6 initial fruiting years.

	Yield Efficiency (bu/a)					
Cultivar	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**
Blaxtayman	61a	152b	163b	334c	574c	15e
Gallia Beauty	46b	84c	225a	434b	535c	325c
Golden Delicious	37b	249a	209a	415b	908a	438b
Jonathan	41b	80c	238a	404b	610bc	309cd
Melrose	—	163b	68c	549a	691b	567a
Red Prince	—	28d	12d	269d	575c	246d

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Use of Ethrel to Stimulate Coloring and Ripening of Minnesota Apple Cultivars[1]

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Increased red color and early maturation of preharvest 2-chloroethylphosphonic acid (Ethrel) treated apples has been reported frequently (3, 4, 5, 7). However, this early fruit maturity and accelerated red color development has been associated with a hastening of abscission of mature apple fruits (3) and a decrease in firmness of the apple flesh (3, 5, 7). Edgerton (3) and Unrath (7) reported that 2,4,5 trichlorophenoxypropionic acid (2,4,5-TP) effectively counteracts the promotion of abscission by Ethrel. They also stated that even though a mid-summer application of succinic acid 2,2-dimethyl hydrazide (Alar), 60 to 70 days before harvest, delayed apple abscission, preharvest application of Ethrel effectively overcame this delay. Alar does, however, improve apple flesh firmness (1, 2) and delay the appearance of the physiological discolor watercore (2).

This study was designed to evaluate mid-summer applications of Alar followed by preharvest applications of Ethrel and 2,4,5-TP on four Minnesota grown apple cultivars, Beacon, McIntosh, Haralson, and Fireside. The value of these treatments alone and in combination were studied by following fruit drop, red color development, fruit firmness, and watercore development.

Materials and Methods

Ethrel alone and in combination with Alar and 2,4,5-TP (for abscission control) were applied in 1976 to 20 year old, entire trees of 4 apple cultivars (Beacon, McIntosh, Haralson, and Fireside) before the fruit reached maturity. All treatments were replicated 3 times. Sprays were applied at 200 psi, dilute, and to run-off using a hand gun.

Alar was applied to Beacon June 25, and the Ethrel and 2,4,5-TP combina-

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