

Performance of Eight Strains of 'Rome Beauty' over Nine Years

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Abstract

Eight strains of 'Rome Beauty' were planted in 1984 and evaluated over nine years for tree size, growth, fruit size, color, shape, yield and scarf skin. Tree size of 'Barkley' tended to be larger and 'Starkspur Taylor' smaller than most of the other strains. 'Starkspur Taylor' had more leaves/spur than 'Stark Red Rome', 'Flamespur', 'Lawspur', 'Spuree' and 'Starkspur Law'. 'Starkspur Law' had smaller spur leaves and leaf area per spur. 'Starkspur Law' tended to have the most lateral flowers on one-year wood and 'Flamespur', 'True Brite', 'Lawspur' and 'Stark Red Rome' the fewest. On two-year wood, 'Barkley' and 'Stark Red Rome' had a greater density of flower clusters than 'Flamespur', 'True Brite' and 'Lawspur', which had the lowest density. 'Lawspur' had a greater density of spurs on two-year wood than any of the other strains. 'Starkspur Taylor' had high early yields and one of the highest cumulative yield efficiencies (yield ÷ trunk cross sectional area (TCA) due to its small TCA. In years with heavy crops (1990 and 1992) 'Spuree' and 'Flamespur' had high yields, while 'True Brite', 'Starkspur Taylor' and 'Stark Red Rome' tended to have lower yields. Fruit of the following strains were consistently nearly completely red: 'Flamespur', 'Lawspur', 'Starkspur Law' and 'Stark Red Rome'. 'Barkley', 'Spuree' and 'Starkspur Taylor' had a lower percentage of the fruit surface pigmented. 'Barkley' consistently produced larger fruit than most of the other strains. In 1988, severe scarf skin occurred and 'Flamespur', 'Lawspur', 'Spuree' and 'Starkspur Law' had lower levels of scarf skin than other strains. 'Barkley' had high levels of scarf skin most years. 'True Brite', 'Lawspur' and 'Starkspur Law' had scarf skin levels below the economic threshold all years except 1988.

'Rome Beauty' originated in Ohio from a sprout on a seedling rootstock purchased in 1816 (7). It has been an important cultivar since that time and increased planting occurred in many fruit growing areas as red strains were identified and planted by fruit growers. In the late 1970's, the development of

severe scarf skin on some of the new, redder strains of 'Rome Beauty', impacted sales (1). In response to grower concerns, a series of studies (2, 3, 4, 6) was initiated to determine the time of initiation of scarf skin and the factors that could influence its development. One of the shortcomings of this work was the ability at one location to evaluate various red strains of 'Rome Beauty' for their relative susceptibility to scarf skin and other tree and fruit characteristics. Commercial nurseries across the country were contacted and trees of the eight most prevalent strains of 'Rome Beauty' were secured for a replicated planting to compare strain performance.

Materials and Methods

In May 1984, trees of the eight strains of 'Rome Beauty' listed in Table 1 were planted at a spacing of 4.5 m x 6 m at the Mahoning Experimental and Educational Farm near Canfield, Ohio. All trees were on M.7A rootstock except 'Flamespur', which was on seedling. The trees were arranged in a randomized complete block design with 10 single tree replications of each strain. Appropriate other cultivars were used as pollenizers.

Trees were trained as free standing central leaders with minimal pruning. Limb spreaders were used to position lower scaffold limbs. Soil management consisted of a herbicide strip in the row with sod between rows. Trees received the standard disease and insect control sprays. The trees were fertilized annually with increasing

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amounts of ammonium nitrate until the trees were 7-years-old (1990) at which time they received .45 kg/tree and this rate was maintained until the trees were removed following the 1992 growing season.

Yield and trunk circumference were recorded annually and in 1992 tree height and spread were measured. Beginning in 1987, a random sample of 10 fruit per tree were removed from the tree periphery at harvest and the following data collected: average fruit weight, % of surface red, fruit length and diameter, scarf skin rating and in most years chromaticity (fruit color) values were collected. Scarf skin was rated from 1 = no scarf skin to 5 = severe scarf skin using the system described by Ferree et al. (4). Fruit color was measured by placing the 8 mm diameter measuring area of a Minolta chromometer at the mid point between stem and calyx end on the blushed surface of each fruit. With this system "L" represents the value (lightness) of colors. It is small for dark colors and large for light colors, a is negative for green and positive for red; whereas, b is negative for blue and positive for yellow. The ratio a/b is presented because Singha et al. (8) found that this ratio provided a good relationship to visual ratings of 'Deli-

cious' strains by panelists. In 1991 severe storage scald occurred on composite samples of the fruit from each strain and the percentage of the fruit surface covered by scald and the severity (intensity of dark color) was rated using a scale of 1 = no scald to 5 = severe dark scald.

In 1989 at pink, length and number of flowers were taken on four one-year-old terminal shoots per tree. Additionally, the two-year-old section on 5 well exposed limbs were selected and the following measurements taken: length, flower clusters, shoots (vegetative longer than 5 cm) and spurs (vegetative shorter than 5 cm). In July of 1989, a sample of five nonflowering spurs on two-year-old wood were collected and the following measurements taken: flowers/spur, leaves/spur, leaf area/spur and leaf dry weight/spur.

Results and Discussion

'Flamespur' being on seedling was larger than any of the other strains which were on M.7A (Table 1). It is recognized that all the data on 'Flamespur' will be confounded because of the difference in rootstock, but it was considered worthwhile to include the data particularly on fruit characteristics because rootstock effects are often small among rootstocks producing rel-

Table 1. Tree size, spur quality, shoot length and density of flowers, shoots and spurs on one- and two-year shoots of eight strains of 'Rome Beauty'.

Strain	Tree size 1992			Spur quality 1989					1989					
	TCA (cm ²)	Height (m)	Spread (m)	Flowers/ spur	Leaves/ spur	Avg/ leaf size (cm ²)	Leaf area spur cm ²	SLW (g/cm ²)	One year shoots		Two year shoots			
									Length (cm)	Flower clusters	Length/ cm	Flower clusters/ cm	Shoots/ cm	Spurs/ cm
Flamespur	145.7a	3.6a	4.5a	6.0	9.1bc	4.7ab	43.1abc	7.4ab	27.4ab	6.1d	35.3a	.12b	.040ab	.036b
Barkley	123.3b	3.3ab	4.2ab	6.1	9.5ab	5.2ab	50.1a	7.5ab	25.8abc	7.7bc	33.9ab	.17a	.042a	.007c
True Brite	90.9c	3.1b	4.2ab	6.3	9.5ab	5.0a	48.0ab	7.7ab	23.3cd	6.2d	34.8ab	.12b	.019bcd	.061b
Lawspur	93.8c	3.1b	4.0b	6.1	9.1bc	4.2bc	39.0cd	7.2ab	25.6abc	6.6cd	32.1b	.08c	.017cd	.083a
Spuree	103.9c	3.3ab	4.1b	6.0	8.7cd	4.8ab	42.3bc	7.1b	28.0a	8.6ab	33.9ab	.15ab	.039ab	.044b
Starkspur Law	94.1c	3.1b	4.1ab	6.0	8.6d	3.9c	34.4d	7.0b	25.7abc	9.0a	33.4ab	.14ab	.017cd	.05ab
Starkspur Taylor	69.4d	3.1b	3.5c	6.0	9.9a	4.9ab	48.7ab	8.1a	20.8d	7.6bc	31.8b	.14ab	.003d	.057b
Stark Red Rome	92.8c	3.1b	4.3ab	6.3	9.3b	4.9ab	46.1abc	8.0ab	23.9bcd	6.4d	33.9ab	.15a	.029abc	.036b

*Mean separation by Duncan's Multiple Range P = 0.05.

Table 2. Yield performance of eight strains of 'Rome Beauty' over nine years.

Strain	Yield/tree (Kg)							Fruit drop 1989 %	Cumulative yield (kg)	Cumulative efficiency (kg.cm ²)
	1986	1987	1988	1989	1990	1991	1992			
Flamespur	.6c	5.8d	12.2b	30.4c	115.1abc	26.9	141.4a	11.3cd	314.5ab	2.22d
Barkley	.5c	6.8d	4.0c	35.8bc	128.4ab	16.1	112.6bc	9.3d	290.3abc	2.37d
True Brite	1.2c	7.0d	13.9b	38.6abc	82.7c	29.7	93.5bc	17.5bc	242.6c	2.67cd
Lawspur	1.1bc	13.9bc	13.2b	39.0ab	93.1c	31.7	103.1bc	15.5bcd	268.5bc	2.87bc
Spuree	.8bc	24.7a	7.8bc	44.7a	142.3a	25.1	119.7ab	18.5b	332.3a	3.21ab
Starkspur Law	1.6b	15.0b	9.7bc	36.5abc	103.9bc	21.6	106.9bc	12.3bcd	207.7bc	2.84bc
Starkspur Taylor	3.1a	23.8a	30.4a	36.1bc	88.0c	22.3	89.8c	52.5a	241.9c	3.56a
Stark Red Rome	.7bc	8.2cd	13.5b	36.9abc	92.2c	23.8	94.0bc	10.3d	245.5c	2.66cd

*Mean separation by Duncan's Multiple Range P = 0.05.

atively large trees (5). Among the strains on M.7A 'Barkley' tended to be large and 'Starkspur Taylor' smaller than the others. There were no differences among the strains in flowers per spur, but 'Starkspur Taylor' had more leaves per shoot than 'Stark Red Rome,' 'Flamespur,' 'Lawspur,' 'Spuree' and 'Starkspur Law.' 'Starkspur Law' had the smallest spur leaves and leaf area per spur with the exception of 'Lawspur.' Although not always statistically significant, 'Lawspur,' 'Spuree' and 'Starkspur Law' tended to have lower quality spurs in all parameters measured compared to the other strains. Most of the one-year-old shoots had a terminal flower cluster which is typical of 'Rome Beauty,' but the strains differed in the number of lateral flower

clusters on one-year wood. 'Starkspur Law' tended to have the most flowers and 'Flamespur,' 'True Brite,' 'Lawspur' and 'Stark Red Rome' the fewest. On two-year wood, 'Barkley' and 'Stark Red Rome' had a greater density of flower clusters than 'Flamespur,' 'True Brite' and 'Lawspur' which had the lowest density. 'Barkley' and 'Flamespur' had a greater density of shoots on two-year wood than 'Lawspur,' 'Starkspur Law' and 'Starkspur Taylor.' 'Lawspur' had a greater density of spurs than any of the other strains on two-year wood.

These trees produced their first fruit in 1986 in their third year with 'Starkspur Taylor' having the highest yield. In 1987, 'Starkspur,' 'Taylor' and 'Spuree' had the highest yields (Table 2). In the

Table 3. Fruit surface red color and chromaticity values from eight strains of 'Rome Beauty.'

Strain	Fruit red surface color (%)					Chromaticity value (a/b)			
	1988	1989	1990	1991	1992	1988	1989	1991	1992
Flamespur	97a	99a	99a	99a	99a	1.75a	3.37a	1.82a	1.89ab
Barkley	67b	96a	78b	86b	65d	1.46d	2.72c	1.64c	1.54e
True Brite	100a	85b	98a	99a	99a	1.73ab	3.30a	1.84a	1.89ab
Lawspur	97a	99a	98a	98a	98a	1.77a	3.23a	1.84a	1.92a
Spuree	78b	88b	78b	89b	87b	1.64c	2.91b	1.74b	1.76cd
Starkspur Law	97a	96a	97a	99a	96a	1.78a	3.24a	1.86a	1.80c
Starkspur Taylor	79b	86b	74b	90b	79c	1.72b	2.89b	1.76b	1.73c
Stark Red Rome	96b	99a	98a	99a	98a	1.77a	3.03a	1.86a	1.86b

*Mean separation by Duncan's Multiple Range P = 0.05.

Table 4. Fruit length to diameter ratio and fruit size of eight strains of 'Rome Beauty.'

Strain	Fruit length/diameter					Average fruit size (g)					
	1988	1989	1990	1991	1992	1987	1988	1989	1990	1991	1992
Flamespur	.77c	.81b	.83b	.81c	.80b	195de	158c	161b	193ab	157de	143bc
Barkley	.87bc	.83ab	.83b	.83ab	.81ab	229a	182ab	192a	201a	199a	161a
True Brite	.77c	.81b	.84b	.82bc	.82a	214abc	167bc	173b	197ab	169cd	156ab
Lawspur	.79ab	.82ab	.83b	.81c	.80b	194e	166bc	164b	185abc	154e	147b
Spuree	.79ab	.86a	.84b	.83a	.82a	191e	185a	168b	181bc	173bc	133c
Starkspur Law	.79ab	.82ab	.84b	.83ab	.80b	201cde	173abc	172b	173c	168cd	132c
Starkspur Taylor	.80a	.83ab	.91a	.83a	.82a	210bcd	166bc	173b	183bc	175bc	144bc
Stark Red Rome	.77c	.81b	.84b	.82bc	.81ab	224ab	182ab	171b	187abc	183b	147b

*Mean separation by Duncan's Multiple Range $P = 0.05$.

fifth year 'Starkspur Taylor' again had higher yields than all other cultivars; however, in subsequent years and its cumulative yield/tree was relatively low, but it had one of the highest cumulative efficiencies due to its small trunk cross sectional area. In 1990 and 1992, these trees had very heavy crops and 'Spuree' and 'Flamespur' had especially high yields, while 'True Brite', 'Starkspur Taylor' and 'Stark Red Rome' tended to have lower yields. In 1991, following a very heavy crop there was no difference in yield among strains. 'Spuree' had a high cumulative yield and high efficiency, while 'Barkley' and 'Flamespur' tended to have a high cumulative yield/tree but due to large tree size had low efficiency. 'True

Brite' and 'Stark Red Rome' tended to have lower cumulative yields/tree and also relatively low efficiency.

The following strains consistently tended to be nearly completely red over the 5 years (Table 3): 'Flamespur', 'Lawspur', 'Starkspur Law' and 'Stark Red Rome'. 'True Brite' was well colored every year except 1989. 'Barkley', 'Spuree' and 'Starkspur Taylor' had distinctly lower percentage of the fruit surface colored. The chromaticity ratio of a (redness)/b (yellowness), shows that 'Flamespur', 'True Brite' and 'Lawspur' consistently had deep red color. In 1992, considerable cloudy weather in the fall resulted in a drop in this ratio for 'Starkspur Law' and 'Stark Red Rome', which had high

Table 5. Scarf skin on fruit of eight strains of 'Rome Beauty' over six years and storage scald in 1991.

Strain	Scarf skin rating ^z						Years of 6 exceed rating of 3	Fruit surface w/scald (%)	Scald severity rating ^y
	1987	1988	1989	1990	1991	1992			
Flamespur	3.1ab	3.6c	3.2ab	2.9ab	2.8bc	2.5bc	3	26.0c	2.41a
Barkley	3.4a	4.2a	3.5a	2.9ab	3.2a	3.2a	5	27.7c	2.74ab
True Brite	3.0a	3.8bc	2.7c	3.0ab	3.0ab	2.6bc	1	29.5c	2.76ab
Lawspur	2.8bc	3.6c	2.6c	2.8ab	2.8bc	2.6b	1	38.2b	3.44cd
Spuree	2.5c	3.6c	2.8c	3.6a	2.6c	2.3c	2	54.9a	3.84cd
Starkspur Law	2.8bc	3.6c	2.8c	2.6b	2.8bc	2.4bc	1	37.5b	3.42bcd
Starkspur Taylor	3.2ab	4.0ab	2.5c	2.9ab	2.8bc	2.7b	2	45.0b	3.32bc
Stark Red Rome	3.2ab	3.8bc	2.9bc	2.8ab	2.9abc	2.7b	2	42.9b	3.98d

^zScarf rating: 1 = no scarf to 5 = severe scarf.

^yScald rating: 1 = no scald to 5 = severe dark scald.

*Mean separation by Duncan's Multiple Range $P = 0.05$.

values the previous three years. 'Barkley,' 'Spuree' and 'Starkspur Taylor' had low a/b ratios indicating lower intensity of red and more yellow.

Although fruit shape is not an important characteristic for marketing 'Rome Beauty,' the length/diameter data show that 'Starkspur Taylor' consistently tended to be rounder than several of the other strains (Table 4). 'Flamespur' tended to be flatter with no clear tendencies for fruit shape of the other strains. Average fruit size among strains varied considerably over the years of the trial, but generally 'Barkley' produced some of the largest fruit (Table 4). 'Stark Red Rome' also had large fruit, but was not always statistically significant from other strains. In 1990 and 1992, when yields were high, fruit of 'Starkspur Law,' 'Starkspur Taylor' and 'Spuree' tended to be small, while 'Barkley' and 'True Brite' tended to have larger fruit.

A level of scarf skin in the range of 2.5-3.0 on the rating scale is normally not a problem with sale of fruit, but levels over 3 (economic threshold) the symptoms become very obvious to the buyer. Of the six years that scarf skin was rated, only in 1988 did the average value for all treatments exceed 3.0 (Table 5). In 1988, 'Flamespur,' 'Lawspur,' 'Spuree' and 'Starkspur Law' had the lowest value for scarf skin, while 'Barkley' and 'Starkspur Taylor' had very severe symptoms. 'Barkley' consistently had one of the highest levels of scarf skin and was below the economic threshold only in 1990. 'True Brite,' 'Lawspur' and 'Starkspur Law' were below the economic threshold all years except 1988.

After completing the ratings for scarf skin the samples for each strain were normally consolidated. In 1991 storage scald developed and it was decided to rate the percentage of fruit surface covered with scald symptoms and the severity or darkness of the most severe scald on 50 fruit of each strain were rated. Means were ranked and separ-

ated based on subsequent pair wise computation at a significance level of 5% (Table 5). 'Spuree' had the greatest surface area exhibiting scald symptoms and 'Flamespur,' 'Barkley' and 'True Brite' the least area and also low scald severity. 'Lawspur,' 'Spuree' and 'Stark Red Rome' exhibited very dark severe symptoms of scald. Significant scald was not observed in other years.

Although 'Barkley' had relatively high cumulative yields/tree, it had low yield efficiency due to its large tree size. It also had much poorer color and its tendency toward severe scarf skin would preclude continued planting. The strains with potential to consistently develop good red color and lower levels of scarf skin were 'True Brite,' 'Lawspur' and 'Starkspur Law.' These three strains had moderate fruit size and reasonably consistent yields and of the eight strains evaluated, would be preferred for future planting.

Literature Cited

1. Byers, M. A. 1977. A scarf skin like disorder of apples. *HortScience* 12(3):226-227.
2. Ferree, D. C. and J. C. Schmid. 1984. Relationship of orchard location and nutrition to scarf skin of 'Rome Beauty' apples. *OARDC Res. Circ.* 283:26-30.
3. Ferree, D. C. and M. A. Ellis. 1986. Influence of fungicide on scarf skin of 'Gallia Beauty.' *Fruit Crops 1986:A Sum. of Res. OARDC Res. Circ.* 290:14-16.
4. Ferree, D. C., M. A. Ellis, and B. L. Bishop. 1984. Scarf skin of 'Rome Beauty': Time of origin and influence of fungicides and GA4+7. *J. Amer. Soc. Hort. Sci.* 109(3):422-427.
5. Ferree, D. C. and R. G. Hill, Jr. 1982. Influence of six rootstocks and herbicides on growth, cropping and fruit quality of 'Blaxtayan' apple trees. *Fruit Crops 1982: A Sum. of Res. OARDC Res. Circ.* 272:1-6.
6. Ferree, D. C., R. L. Darnell, R. D. Fox, R. D. Brazee, and R. E. Whitmoyer. 1984. Environmental and nutritional elements associated with scarf skin of 'Rome Beauty' apples. *J. Amer. Soc. Hort. Sci.* 109:507-513.
7. Mowry, J. B. 1970. IX Rome in North America. Apples: Varieties, rootstocks, outlook. *Mich. State Univ. Press, E. Lansing, MI.* pp. 128-138.
8. Singha, S., E. C. Townsend and T. A. Baugher. 1991. Relationship between visual rating and chromaticity values in 'Delicious' apple strains. *Fruit Var. J.* 45(1):33-36.