

Spur Strains of McIntosh Discovered in British Columbia, Canada

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The discovery in 1964, 1967, 1968 and 1969 of a number of spur-type mutations of McIntosh provides a selection of strains for a grower wishing to plant a compact form of this cultivar. While some of the strains could have originated from a common bud stick, it is equally certain that, because of striking inherent differences, others are quite unrelated. Taking all factors known to the author into account, it is considered likely that each strain represents a separate mutation.

All strains are characterized, in greater or less degree, by compact growth habit, with reduced distances

between nodes, limited side branching on shoots, and heavy development of fruit spurs. All sports have a more stiff, upright, growth habit than regular McIntosh, and none is prone to the "blind" wood condition so common with the parent cultivar. These sports, in general, are considered to have a higher vigor level than spur strains of Golden Delicious or Delicious. Leaf color is deeper green than with McIntosh, and observations with several strains suggest a marked degree of resistance to powdery mildew infection. All strains, with one exception, are reported to be sports of

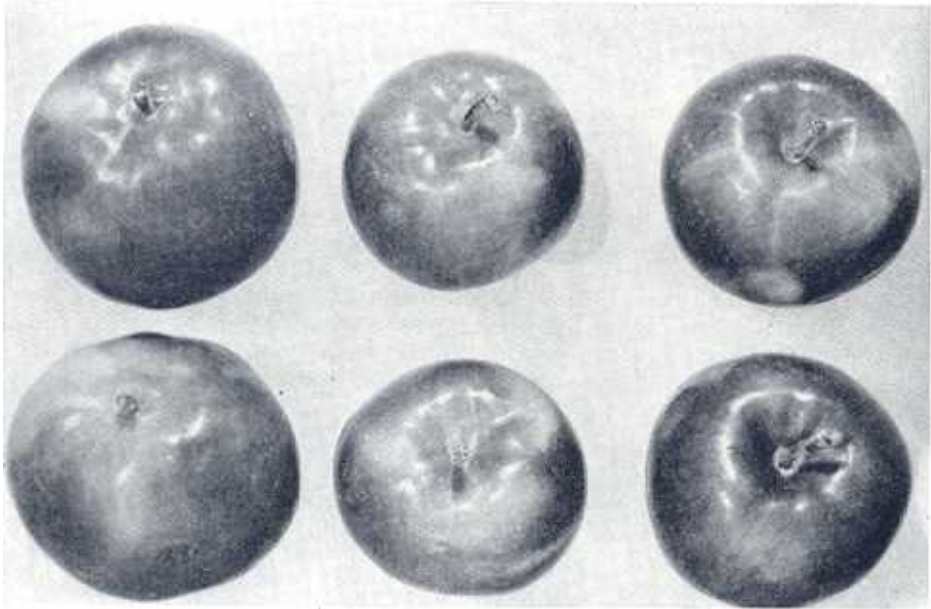


Fig. 1. Abnormal McIntosh with shallow to flat stem cavities and short stems (4 apples on left). The stems are often poorly attached and fleshy (lower left hand specimen). Upper and lower right hand apples are normal.

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the Summerland Red McIntosh, and all but one are blush color strains, similar to Summerland Red.

The origins of five of these strains, together with certain orchard data, are listed below under the letter designations A to E.

Strain A, from the Kelowna area, was the first one reported. The grower discovered it in 1964 as a single shoot arising from a bench cut at the top of a 50-year-old tree. The fruit is very short stemmed, oblate, inadequate in color and later maturing, but is typical McIntosh in flavor and texture. Pollen of this strain used on Golden Delicious has produced nearly 50 percent of spur type seedlings. This ability to transmit its tree type to progeny may make it a very valuable breeding parent. It is not sufficiently vigorous for commercial orcharding and not assigned to any nursery, but might be valuable as a tree to grow on a patio or in a small city garden.

Strain B is in a small block of McIntosh on seedling roots planted in 1960 or 1961 in a Summerland orchard. The owner had noted from the time of planting that the tree was different in appearance and had a very early and heavy bearing habit. It was bought jointly in 1967 by an Eastern U.S. nursery and by the British Columbia Fruit Growers' Association, which holds propagating rights on behalf of B. C. orchardists and



Fig. 2. Close-up view of a branch of spur McIntosh just before harvest. Note stiffness of branch under heavy fruit load.

nurseries. The American nursery has applied for patent rights in the U.S. for this strain.

The tree has an upright growing habit with limited side shoot development from main limbs. It is vigorous despite its spur-type habit and bears heavily and annually. It is a sport of Summerland Red McIntosh and shows good blush color. The owner claims it has greatly out-produced all other similar aged McIntosh trees in the same planting, and that following the April 17, 1968 spring frost, fruit bud survival was much higher than for standard McIntosh. In the nursery, budded trees show a unique side branching habit right up the stem, distinct from the habit of regular McIntosh. The tree has shown marked resistance to powdery mildew infection.

Strain C was reported in 1968 from Oyama, B. C., where it occurred as a single tree sport of Summerland Red McIntosh worked on a seedling rootstock and planted about 1960. The strain has been assigned to an American nursery. This strain, while apparently a compact mutant of McIntosh, differs from the other strains in its more spreading and more freely branching growth habit. It has, however, the dark green leaves and heavy fruit setting habit characteristic of other spur strains. It appears to be the most vigorous of the strains.

Strain D: There are 6 apparently identical whole tree mutants of this strain in a large block of Summerland Red McIntosh located in the Kelowna district. The trees were propagated on M VII roots and planted about 1960. This strain has been sold to an Ontario nurseryman. Trees of this strain tend to develop a few large, strong framework branches with very limited side shoot development. In 1968 the fruit was a good blushed color and of remarkable size in relation to the large crop on the trees.

Although the 1968 crop was extremely heavy, there was a fair crop on some trees in 1969, with almost none on regular McIntosh in the same block.

Strain E was discovered as a single tree at Oyama, B. C. in 1968 and a second tree was discovered in the same orchard in 1969. The tree was planted as Summerland Red McIntosh on M XVI rootstock in 1962. The trees are sturdy, compact, and with limited side branching from main limbs. They show the typical heavy leafing and dark green leaf color of other McIntosh spurports, and at 7 years of age are about 2/3 the size of similar aged McIntosh in the same block. The crop is heavy, and skin color typical of Summerland Red McIntosh.

Experimental Methods

Since information presently available is inadequate to determine the relative merits and characteristics of the different strains of spur McIntosh,

experiments were initiated in 1969 to provide objective evaluations of these different mutations. These tests will be continued for several years.

Two loose bushel boxes of fruit from trees of strains B to F, together with similar samples from regular McIntosh, were harvested at what appeared to be good maturity, one on September 9 and five on September 15. Measurements were made on 50 apples from each strain to determine maximum and minimum breadth and maximum and minimum length. From these measurements ratios were developed for:

1. Mean length to mean breadth
2. Minimum length to maximum length
3. Minimum breadth to maximum breadth

For each set of data coefficients of variability were calculated. Ratios were considered more informative

Table 1. Shape measurements of McIntosh and spur strains of McIntosh with coefficients of variability (CV)*.

Strain	Ave. Length		Min. Length		Min. Breadth	
	Ave. Breadth	C.V.*	Max. Length	C.V.	Max Breadth	C.V.
B check	.81	4.5	.91	4.1	.94	3.6
spur	.83	4.6	.91	4.5	.95	2.4
C check	.85	4.9	.91	4.1	.94	2.9
spur	.82	5.7	.91	4.9	.95	2.8
D check	.81	5.7	.88	5.9	.95	2.6
spur	.78	6.8	.89	5.9	.95	3.5
E check	.82	4.5	.89	5.1	.95	3.0
spur	.85	5.7	.91	5.7	.95	3.3
F check	.81	3.4	.89	5.8	.95	3.4
spur	.81	4.2	.90	5.1	.95	4.2
Avg.						
check	.82	4.6	.90	4.9	.95	3.1
spur	.82	5.4	.90	5.2	.95	3.2

*Coefficient of Variability is a measure of variation in which standard deviation is expressed as a percentage of the average. The larger the value, the greater is the variability in the characteristic being measured.

than actual measurements, since the latter reflected variations in fruit size resulting from differing cultural conditions.

In addition, approximately 120 apples from each lot were evaluated to determine percentage occurrence of:

1. Flat or shallow stem cavity
2. Fleishy or slightly fleshy stems
3. Short stems

These are depicted in Figure 1.

In the laboratory, both at harvest and after 4 months at 31°F, fruit firmness was measured by means of a 7/16 inch Ballauf apple penetrometer applied to peeled flesh, and percentage soluble solids and titratable acid of juice was recorded. Core flesh was evaluated in the cold stored samples 7 days after January removal of the fruit to 70°F.

One bushel of each strain with checks was placed in CA storage at harvest and removed on February 16th to 70°F for examination.

Results

Shape—All shape ratios showed very small differences between spur strains and checks in the same orchard, and between the individual spur strains and their corresponding checks (Table 1). In fact, the average for all spur strains was identical to the average of the regular McIntosh. The coefficients of variability, however, were slightly higher for the spurs indicating slightly greater shape irregularity in spur strains. Coefficients of variability for the ratios of minimum to maximum breadths, however, were lower than for corresponding minimum to maximum lengths indicating in both spur strains and in standard McIntosh greater uniformity in width than in length dimensions.

Stem and Stem End Characteristics—Some striking, although not consistent differences were found between different spur strains, and between them and their checks in respect to apple stem end shape and length and thickness of stems (Table 2). No at-

Table 2. Summary of stem and stem cavity characteristics of spur vs. standard McIntosh, expressed in percent.

Strain	STEM CAVITY			STEM	
	Flat %	Shallow %	Flat-Shallow %	Short %	Fleshy %
B check	1	25	26	11	0
B spur	18	37	45	44	12
C check	5	19	24	39	11
C spur	7	19	26	31	5
D check	2	6	8	20	19
D spur	2	3	5	30	13
E check	1	16	17	15	6
E spur	19	15	34	27	7
F check	1	5	6	9	2
F spur	1	13	24	33	7
Avg.					
check	2	14	16	19	8
spur	9	19	37	33	9

tempt can be made to assert that differences shown in the table between strains are real, because of the inability to obtain suitable statistical replications from only single tree mutations. However, the average values for all spur strains compared with all checks shows that there was a higher incidence of flat and shallow stem end cavities in spurs than non spurs; almost twice as many short stems in the spurs; but no greater tendency for fleshy stems in standard McIntosh than in spur strains. Of all these abnormalities, probably the only one of any great significance is the greater tendency to flat or shallow stem cavity with which is often associated with a weak stem attachment.

Firmness, Soluble Solids and Acid
—Small but consistently higher soluble solids at harvest were found in regular McIntosh than in spur strains (Table 3). The opposite trend shown by similar readings taken after 4

months at 31°F may be due to differences in amount of carbohydrate in the form of starch which is hydrolyzed during storage to increase soluble solids. Acid content did not appear, on the average, to differ between spur and regular McIntosh. Fruit of spur strains appeared slightly softer than that from regular McIntosh at harvest and slightly firmer after 4 months at 31°F. Only spur strain D and its check appeared softer than others; this was probably due to much larger fruit from a lighter crop with this strain.

Apples from Controlled Atmosphere Storage—After 5 months of C.A. storage, fruit samples showed some differences between strains and between strains and their checks, in firmness, solids and acidity, but not such as to indicate essential differences between strains. Flavor and appearance were satisfactory for all strains and after one week at 70°F, no coreflush developed in any lot.

Table 3. Comparison of spur strains of McIntosh at harvest and after 4 months at 31°F—firmness, soluble solids, and titratable acid calculated as malic.

Strain	AT HARVEST			AFTER 4 MONTHS AT 31°F			
	Firmness lbs.	Soluble solids %	Titratable acid %	Firm. lbs.	Sol. solids %	Tit. acid %	Core flush*
B check	15.0	12.4	.86	8.6	12.1	.59	slight
spur	15.0	11.6	.96	9.0	12.4	.52	slight
C check	15.9	12.7	.94	8.2	11.7	.53	slight
spur	13.9	11.8	.84	9.5	13.0	.48	slight
D check	13.8	13.1	.98	8.2	11.4	.44	slight
spur	13.1	11.4	.86	8.5	12.4	.58	slight
E check	15.0	12.4	.77	8.9	11.8	.44	slight
spur	14.3	11.8	.79	9.5	12.4	.43	slight
F check	16.2	11.8	.69	8.8	12.2	.48	0
spur	16.3	11.0	.71	8.2	12.0	.40	0
Avg.							
check	15.2	12.3	.85	8.5	11.8	.50	
spur	14.5	11.5	.83	8.9	12.4	.48	

*After 7 days at 70°F.

Table 4. Comparison of spur strains of McIntosh after 5 months C.A. storage (2.5 O₂, 5.0 CO₂ 36°F)—firmness, soluble solids and titratable acid calculated as malic.

Strain	Firmness lbs.	Soluble solids %	Titratable acid %	Flavor	Coreflush*
B check	10.9	12.5	.54	F - G	0
spur	9.6	12.1	.67	F - G	0
C Check	10.2	13.1	.61	F - G	0
spur	10.6	11.8	.56	F - G	0
D Check	9.9	12.4	.62	F - G	0
spur	9.3	11.4	.50	F - G	0
E Check	10.8	12.8	.50	F - G	0
spur	11.0	12.0	.53	F - G	0
F Check	10.3	12.0	.45	F - G	0
spur	10.8	12.3	.45	F - G	0
Avg.					
Check	10.4	12.6	.54		0
spur	10.3	11.9	.54		0

*After 7 days at 70°F.

Discussion and Summary

The discovery of spur-type trees of McIntosh in seven orchards in the interior fruit area of British Columbia opens up great new possibilities in commercial production of this cultivar. The strains are considered mostly (if not all) separate mutations of McIntosh, five of them of Summerland Red McIntosh. Some strains differ markedly from others in growth habit, but all are readily identified as spur-types or compacts. This compact habit with strong development of fruit spurs on two-year wood rather than side shoots, results in sturdy, early and heavy bearing trees which should lend themselves well to restrictive pruning methods employed in high density plantings.

One year's data indicates that fruits of these spur strains probably do not differ greatly from one another or

from regular McIntosh in length to breadth ratio, firmness, chemical composition or keeping life, but there is a significantly greater tendency in spur types toward short fruit stems and flattened stem cavities. These abnormalities may have been accentuated by injury to fruit spurs from the extremely cold 1968-69 winter, and may not be significant in most years. Several more years observations are needed in order to evaluate accurately the characteristics of these spur strains of McIntosh. In the meantime, extensive commercial plantings of spur McIntosh at high density plantings will add significantly to our knowledge.

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