

Winslow — no description available.

Winter Queen — no description available.

Wisconsin — no description available.

Woolman — discovered by A. W. Woolman, Indian Mills, N.J. in 1897. Fruit: midseason, deep red, 105 cupcount, good-very good production, fair keeping quality. Vines: medium texture, medium size, large leaves. (1)

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Variations in Growth and Productivity Among Macspur Apple Trees, and Growth Comparisons between Spur and Nonspur McIntosh and Delicious Cultivars¹

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Abstract

Some Macspur apple (*Malus domestica* Borkh) trees in plantings in northeastern United States and Canada have the growth habit of McIntosh. Such "non-spur" trees at the Horticultural Research Center in Belchertown, MA were larger, more productive and had more lateral branching than truly spur-type Macspur trees. In another study, tree size and lateral branching of young Imperial McIntosh and Imperial Red Delicious differed from spur strains of these cultivars. Spur strains of McIntosh differed from each other. However, Macspur, Morspur, and non-spur Imperial McIntosh were similar in branching and trunk x-sectional area. Tree size and lateral branching of Imperial Red Delicious were greater than those of the spur strains tested of the cultivar. It was concluded that Macspur trees may be subject to bud reversion.

The first naturally occurring mutants of McIntosh were discovered in the Okanagan Valley, British Columbia during the 1960's (3). Strain B

(Macspur) and strain D (Morspur) were more spurry than strain E (Dewar) and produced very few lateral branches on structural limbs (4, 5). Strain C (Gatzke) was the least spurry of these strains. Lapins (4) reported that trees of Gatzke, Dewar, and Macspur were 70 to 80%, and Morspur 60% of the size of Summerland Red McIntosh. The mutant strains were reported to have greater potential for early and heavy cropping than McIntosh trees with standard growth habit but no data were presented (3, 5).

Macspur is the most heavily planted McIntosh mutant in the northeastern United States. In 1975 we noted some trees in a 50-tree block of this strain planted in 1971 at the Horticultural Research Center (HRC), Belchertown, MA exhibited the growth of McIntosh

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being a spreading-type tree with many secondary branches on the structural limbs. Subsequent observations revealed variability among Macspur in orchards throughout northeastern United States and Canada. By 1960 there were 88 named Delicious strains (1) but the problem of variability within strains has been minor (7) compared to that being encountered with the recently introduced Macspur. This study was initiated to: (1) observe and compare the growth and fruitfulness of trees within a Macspur block that were very spurry and produced very few lateral branches with those that had the growth characteristics of McIntosh; and (2) compare the growth of McIntosh and Delicious spur and non-spur strains in a separate block of trees.

Annually starting during the growing season of 1975 the growth habit of each of the 50 Macspur trees at the HRC was visually classified independently by 2 individuals as spur-type, non-spur or questionable. Trees rated as questionable were those that were neither extremely spurry and non-branching nor had the growth habit of standard-type McIntosh trees. In some instances spurry and non-spurry branches were borne on the same tree. Yield was recorded annually. Trees with questionable growth development were excluded. Trunk circumference of each tree classified as spur or non-spur was measured 53 cm above the soil line in November, 1982 and then converted to cm² cross-sectional area, which has been shown to be linearly related to total tree size (9). Production efficiency index, (which is a measure of yield per unit of tree size) was calculated by dividing yield by cm² trunk cross-sectional area. In December, 1982, branch spread and tree height were determined. Also, 2 structural limbs were selected on each tree and their length and circumference were measured and their numbers of secondary branches on each

structural limb were counted. All data were subjected to a 1-way analysis of variance.

A planting established at Wilbraham, MA in 1979 included the following Delicious and McIntosh strains on Malling M-7a rootstocks: Delicious—Imperial Red, Redspur, Red King Oregon Spur, Red Chief, Starkrimson (Bisbee strain); McIntosh—Imperial, Morspur, Macspur, Eastman and Gatzke. Imperial, Red Delicious and Imperial McIntosh have standard types of growth habit and the others are spur strains. The experiment was a randomized block design with 8 blocks and 5 strains of each cultivar per block. The trees were not allowed to set fruit and after leaf abscission in 1982 trunk circumference was measured at a line painted 46 cm above the ground on the trunk. Two structural limbs that developed the year of planting were tagged. The length, circumference and number of lateral branches more than 20 cm in length were determined for each tagged limb. For statistical analysis, the treatment sum of squares was partitioned into 5 components shown in Table 2. Then Dunnett's procedure was used to test each of the spur trees in turn against the non-spur trees (2). This was done separately for the McIntosh and Delicious cultivars.

Macspur trees at the Horticultural Research Center. Twenty-five percent of the trees in 1975 exhibited and continue to show growth characteristics of standard McIntosh. At the completion of growth in 1982, these trees in comparison to the spur-type Macspur trees were taller, had a larger crown (branch spread), and more lateral branching (Table 1). The non-spur trees have produced more fruit than the spur trees but have lower production efficiency.

Some observers (7) have attributed this variation to accidental mixing of bud wood by propagators. We noted that 5% of the trees in the Macspur

Table 1. Growth and yield of Macspur apple trees characterized as having spur or non-spur growth habit^z.

Parameter	Year	Spur	Non-spur
Yield/tree (kg)	1975	15a ^y	15a
	1976	30a	27a
	1977	37a	28a
	1978	75a	95a
	1979	34b	56a
	1980	87a	96a
	1981	57b	98a
	1982	131b	173a
Cumulative yield, 1975 to 82 (kg/tree)		472b	589a
Production efficiency, 1975 to 82		4.29a	3.16b
Trunk cross-sectional area (cm ²)	1982	151a	197a
Tree height (cm)	1982	348b	428a
Branch spread (cm)	1982	369b	464a
Lateral branches/m branch length	1982	1.1b	2.4a
Lateral branches/cm limb circumference	1982	0.2b	0.4a

^zTrees planted in 1971.^yMeans separation in rows by Duncan's multiple range test, 5% level.**Table 2. Analyses of variance of length of structural branches, secondary branching on structural limbs, and trunk cross-sectional area of McIntosh and Delicious strains^z.**

Source of variation	Degree of freedom	Length of structural branches	Mean square		Trunk cross-section area
			Lateral branching		
			per meter of limb length	per cm limb circumference	
Blocks	7	2,486	1.00	0.05	2.58
Treatments:	9	35,113** ^y	6.22**	0.44**	33.46**
Cultivars	1	91,937**	11.81**	0.99**	16.93**
McIntosh: spur vs. nonspur	1	23,937**	9.60**	0.68**	32.22**
McIntosh: among spurs	3	12,723**	4.48**	0.28**	35.81**
Delicious: spur vs. nonspur	1	158,697**	20.66**	1.46**	127.09**
Delicious: among spurs	3	1,091	0.16	0.01	5.81
BT	63	2,732	0.81	0.04	2.93

^zTrees planted 1979; data taken December, 1982.^y**Significant at 1% level.

Table 3. Length of structural branches, secondary branching on structural limbs and trunk circumference cross-sectional area as influenced by strains of McIntosh and Delicious^a.

Cultivar ^b	Mean length of structural branches (m)	Lateral branching per meter of limb length	per cm limb circumference	Trunk cross-sectional area (cm ²)
McIntosh:				
Imperial	1.8	2.8	0.71	16.7
Macspur	1.7+ ^w	2.1+	0.51+	16.0+
Morspur	1.5+	1.9+	0.47-	14.3+
Gatzke	1.4-	1.9+	0.44-	11.3-
Eastman	1.3-	0.5-	0.11-	7.0-
Delicious:				
Imperial	1.8	2.5	0.60	16.6
Oregon	1.1-	0.9-	0.16-	11.3-
Red Chief	1.1-	0.8-	0.14-	9.5-
Redspur	1.0-	0.6-	0.11-	9.5-
Starkrimson	0.9-	0.6-	0.10-	7.6-

^aTrees planted in 1979. Measurements made December, 1982.

^bThe Imperial strain of both cultivars is a nonspur. The other strains are spurs.

^wMeans for each cultivar followed by (+) do not differ from the nonspur. Means followed by (-) do differ from the nonspur.

block at the HRC had some very spurry structural limbs which have produced very few laterals whereas other limbs showed the growth habit of McIntosh. In one instance a bud behind a stubbing cut on a spurry structural branch of 1 tree has produced a vigorous branch with standard-type growth habit. We have observed similar variability in commercial plantings of Macspur in eastern United States and Canada. Visual evaluation of Macspur trees in some plantings showed that as high as 70% of the trees had standard-type growth habit rather than being very spurry. The authors have seen no reports of such variability within blocks of spur strains of Delicious. We believe that the variable growth habit of Macspur trees is possibly due to a high incidence of bud reversion. D. H. Peterson, Hilltop Orchards and Nurseries, Hartford, MI (personal commu-

nication) also attributes the Macspur variability to bud reversion.

McIntosh and Delicious strains at Wilbraham, MA. Tree size and lateral branching of Imperial McIntosh and Imperial Red Delicious differed from those of their spur strains (Table 2). The spur strains of McIntosh differed from each other, but the spur strains of Delicious did not differ. Dunnett's test (2) showed that Imperial McIntosh, Macspur and Morspur were similar in size based on trunk cross-sectional area and length of structural branches whereas Gatzke and Eastman were smaller (Table 3). This appears surprising since Gatzke is only a semi-spur and the original Morspur and Macspur trees were very spurry (3). However, some of the Morspur and Macspur trees had a growth habit similar to that of Imperial McIntosh and hence, there were significant dif-

ferences for the growth measurements taken among the 3 strains (Table 3). Walsh (8) also reported that young Macspur and Imperial McIntosh trees were similar in size but concluded that Macspur may eventually become smaller than the nonspur McIntosh because of cropping. However, he may have been observing some reverted Macspur trees. The variability among Morspur may be due to careless mixing of propagating wood (D. V. Fisher, British Columbia, personal communication). The Eastman strain appears very spurry and compact but it has not been planted extensively and whether bud reversion will become troublesome is not known.

In summary, the variable growth of spur strains of McIntosh is troublesome both from the commercial and research standpoint. Variable tree growth can cause tree crowding because spur trees of a cultivar are generally planted closer than non-spur trees (6). Variable tree size and growth habit among Morspur and Macspur trees make research with those 2 strains difficult.

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The Marshall McIntosh

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During the last several years, thousands of Marshall McIntosh trees have been planted in New England. The demand has exceeded the supply because until recently the only source of this strain was a small nursery in Maine. We have described below the origin, growth habit and fruit of the Marshall McIntosh because of inquiries about the strain from other McIntosh-growing areas.

Marshall McIntosh is a non-spur strain that originated as a branch mutation of McIntosh in the orchard of the Marshall Farm, Inc., 340 Marshall Road, Fitchburg, Massachusetts 01420. The mutation was noticed in 1967 when the fruit developed red color 2 or 3 weeks earlier than those on the rest of the tree.

The Marshall brothers have found that the Marshall strain can be har-

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