Multi-State Cooperative Apple Interstem Planting Established in 1976[1]

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'Scion/rootstock and interstem effect on apple tree growth and fruiting'

Evaluations of potential apple rootstock and interstem systems have been conducted independently by many states in the past. The lack of common planting materials, spacing and handling procedures made comparison of the results of these studies difficult. This difficulty coupled with the growers' desire to plant smaller, more efficient trees has resulted in serious crowding problems, as many trees were planted too close for their growth potential on particular soils.

In order to overcome the above problems, the NC-140 stock-scion committee initiated a series of plantings to evaluate new rootstock and interstem systems by means of cooperative plantings. Through cooperative testing in a number of fruit growing areas, each investigator could benefit from the tree performance on other soil types and climatic conditions. Through the diversity of climatic conditions at the various sites, it should be possible to expose the trees to a wide range of test conditions in a relatively short time.

Progress on the first cooperative planting is reported here and compared two scion cultivars with an M9 interstem for dwarfing on three vigorous rootstocks. Two of these rootstocks, Ottawa 11 and Antonovka seedlings, should provide tree stability and be cold-hardy. The clonal rootstock, MM111, was used as a standard that has shown good soil adaptability, but lacks precocity when used alone.

Materials and Methods

Trees for this study were propagated by double grafting scions of Sturdeespur Delicious and Empire on a 15 cm (6") piece of M9 and subsequently grafted to rootstocks of MM-111, Ottawa 11, and seedlings of Antonovka. The trees were grown in the nursery for one year and in the spring of 1976 sent to the 10 cooperative states listed in Table 1. The trees were planted according to a separate randomized plan for each state at a spacing of 3.66 m x 5.49 m (12' x 18') with the lower union of the interstem 5 cm (2") above the soil line. The trees were trained to a central leader and pruned by a uniform set of guidelines established by the NC-140 committee. The treatments were arranged in a randomized complete block design with 7 individual tree replicates. Due to a shortage of trees, IL did not receive Sturdeespur/111 and Empire/Ottawa 11.

The following data was collected annually for each tree: interstem circumference, scion circumference, number of root suckers, tree height, tree spread, yield/tree, and average fruit weight. Weather data was also collected on a monthly basis for each site. A soil sample was taken prior to planting and again in August 1980. A composite sample of mid-terminal leaves from each treatment was taken in August 1980.

[1]Approved for publication as Journal Article No. 2031-81 of the Ohio Agricultural Research and Development Center, Wooster, OH.

[2]Cooperators: Illinois, Roy K. Simons; Indiana, Richard Hayden; Iowa, Paul Domoto; Kansas, Neil Miles; Kentucky, Raymond Lockard; Massachusetts, William Lord; Michigan, Robert Carlson and Ronald Perry; Missouri, J. A. Hopfinger; Ohio, David Ferree; Wisconsin, Franklin Gilbert.

Results and Discussion

Survival data indicate that in only 2 states (IL, IA) did all the trees live through the first 5 years and MA and WI experienced the greatest tree losses with 19% of the trees missing (Table 1). Severe frost heaving of the KY site in 1978 resulted in very poor growth in 1979 and a decision to remove all trees in 1980. There appeared to be no differences in rootstock regarding injury from soil heaving. Survival of interstem trees on MM111 has been slightly greater than the other 2 rootstocks in this study. The greatest loss occurred with trees of Sturdeespur on Ottawa 11 with a complete loss of this combination in WI.

A comparison of the 1980 data on tree size and yield of the various interstems across the states indicates that generally larger trees occurred in IL, IA, KS, MO and OH than in MA, MI and WI with the smallest trees in the IN site (Table 2). Generally, locations with better growth and larger tree size also had the greatest early yields (data not presented) and production efficiency; however, additional years of data are needed to be certain that early production will predict long-term efficiency.

Interstem trees on MM111 were 15-20% smaller than those on Antonovka seedling or Ottawa 11 for both cultivars (Table 3). Empire trees were larger than Sturdeespur trees, as indicated by a 34% greater trunk cross-section, 19% greater trunk circumference, 8% greater height and 43% greater spread. In a comparison of trunk circumference, it is obvious that the trend for trees of both cultivars on Antonovka and Ottawa 11 to make greater growth than trees on MM 111 remains over the years (Fig. 1). In fact the slope of the curve appeared to flatten and the difference became greater between the fourth and fifth year (1979-1980). Ottawa 11 tended to produce fewer root suckers than Antonovka or MM 111. Trees in MO and OH produced nearly twice as many root suckers as in other states

Table 1. Cooperators and tree survivability in the regional interstem planting established in 1976 by the NC-140 committee.

		Tree Survival After 5 Years*						
		Sturdeespur/M9/			Empire/M9/			%
State	Cooperator	MM 111	Ant.	O-11	MM 111	Ant.	O-11	Survival
IL	Roy Simons**	—	7	7	7	7	—	100
IN	Richard Hayden	7	7	7	7	6	6	95
IA	Paul Domoto	7	7	7	7	7	7	100
KS	Neil Miles	7	5	7	7	6	7	93
KY	Raymond Lockard***	—	—	—	—	—	—	
MA	William Lord	7	5	4	5	6	7	81
MI	Robert Carlson and	7	7	5	7	7	7	90
MO	Ronald Perry							
OH	J. A. Hopfinger	7	7	7	7	6	7	98
WI	David Ferree	6	6	6	7	7	7	93
	Franklin Gilbert	7	7	0	7	7	6	81
	% Survival	98	92	79	97	93	92	

*All states originally received 7 trees of each combination.
**Due to a shortage of trees, IL did not receive trees of Sturdeespur/MM111 and Empire/Ottawa 11.
***All trees removed in 1980 due to severe heaving in the winter of 1978.

(Table 2). A general relationship seemed to exist between more root sucker production and larger tree size. Several states observed fireblight strikes on Antonovka rootsuckers in 1981 and concern exists for the survival of those trees. The trees produced their first yield in 1979 and the early bearing tendency of Empire resulted in greater production than Sturdeespur. These early yield and growth data do not provide adequate information to evaluate the potential of these rootstocks for interstem systems, but do identify potential differences that will be verified by future data.

One of the main purposes of cooperative rootstock studies is to identify growth and yield potential of various stock/scion combinations under different climatic and site conditions. The interstem combinations in the 5 years of this study have already experienced temperature minimum of −32.2°C in IA in 1979 and −30.6°C in WI in 1977 and 1979. The trees were

Table 2. Tree size and rootsuckering in 1980 of M9 interstem apple trees in a regional planting established in 1976.

	Trunk Cross-Sectional Area (cm^2)						Root Suckers/Tree					
	Sturdeespur/M9			Empire/M9			Sturdeespur/M9			Empire/M9		
State	MM111	Ant.	O-11	MM111	Ant.	O-11	MM111	Ant.	O-11	MM111	Ant.	O-11
IL		13.5	16.4	12.8	14.9			8.3	9.0	8.7	7.6	
IN	2.0	7.2	4.4	7.5	10.8	8.2	8.3	15.4	11.7	12.9	12.3	8.1
IA	11.3	15.1	18.4	12.7	20.5	21.9	5.6	6.1	9.1	1.9	4.4	3.2
KS	12.3	13.3	22.6	19.9	27.5	33.3	9.8	9.6	2.9	7.0	8.8	1.5
MA	5.7	9.0	6.6	11.4	12.6	12.8	7.4	9.4	4.3	11.4	10.0	4.9
MI	5.8	7.5	5.7	8.5	12.3	11.3	10.3	7.4	12.8	17.6	14.1	6.9
MO	9.9	12.6	19.6	15.2	15.5	25.6	32.4	22.6	34.8	22.0	11.0	8.7
OH	15.8	17.2	12.9	17.3	33.6	28.1	28.3	25.5	10.4	9.3	22.8	14.5
WI	5.3	9.8		10.5	13.7	8.6	3.9	6.6		4.6	4.4	1.7
LSD 5%				5.8						8.84		

Table 3. Size of M9 interstem apple trees in the regional planting, established in 1976.

		1980			
Cultivar	Rootstock*	Trunk circumference (cm)	Tree ht. (m)	Tree spread (m)	Root suckers/tree
Sturdeespur	MM 111	9.85c**	1.72c	.97d	13.3a
	Antonovka	11.77bc	1.90b	1.29c	12.3a
	Ottawa 11	12.26b	2.06a	1.33c	11.9a
Empire	MM 111	12.44b	1.90b	1.79b	10.6a
	Antonovka	14.66a	2.13a	2.20a	10.6a
	Ottawa 11	14.66a	2.13a	2.29a	6.2b

*All trees with 15 cm interstem of M 9 planted with the entire interstem above ground at a spacing of 3.66m x 5.49m (12′ x 18′).
**Mean comparison LSD .05.

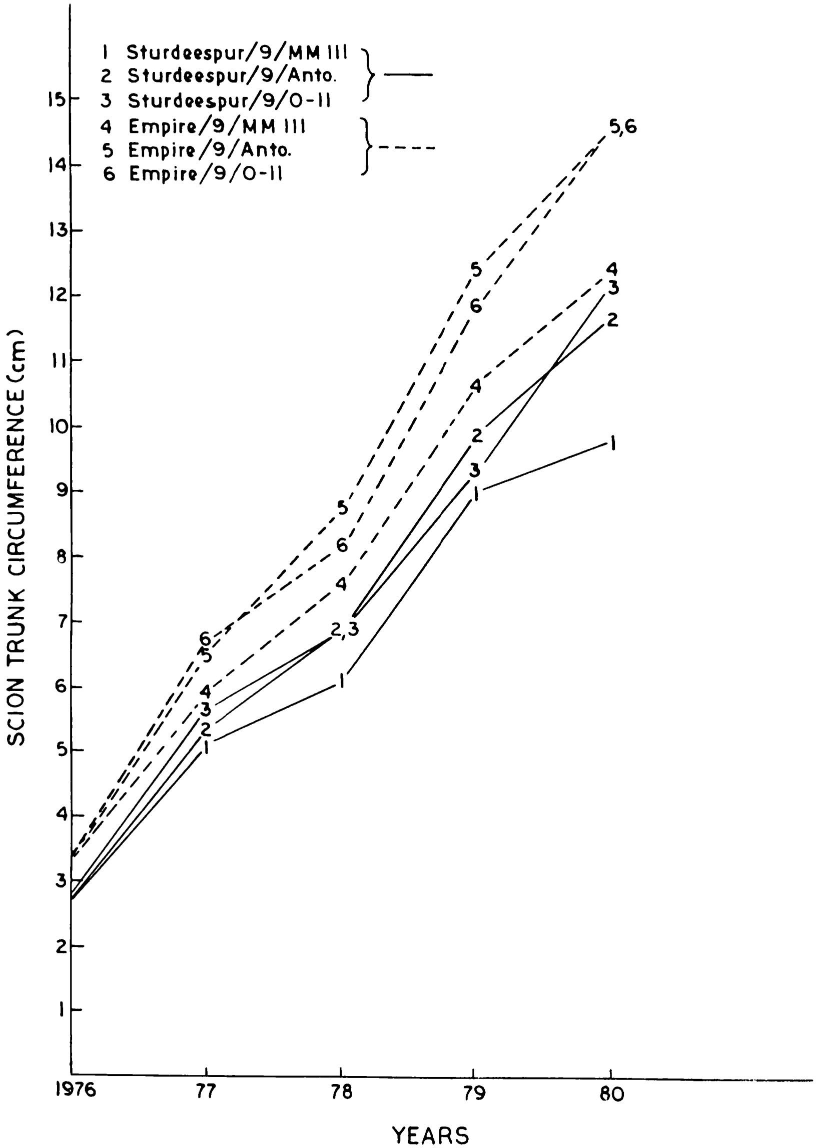

Fig. 1. A comparison of trunk circumference measurements of the M 9 interstem apple trees in the regional planting established in 1976.

also exposed to temperature maximums of 42.8°C in KS and MO, where the average maximum temperature for July 1980 was 38.9°C in both states. The correlation coefficients of the growth parameters with data from soil analysis and weather data are presented in Table 4. Trunk circumference was a measurement with good association to all the other growth parameters of the tree (yield r = .76, spread r = .87, height r = .91) including root sucker production (r = .71).

The scion rootstock combinations used in this study created slight differences in several leaf nutrient levels in 1980, but a consistent pattern was not observed (Table 5). This may be one aspect of the study that should be expanded in the future to determine the potential impact of various scion systems on leaf nutrient concentrations.

Although ultimate conclusions on scion efficiency and adaptability cannot be reached from this preliminary data, it is clear that significant differences exist in root suckering potential of vigorous rootstocks used as root systems for interstem trees. An association also appears to exist between increased suckering and vigorous scion growth. We have also confirmed that producing interstem trees through double grafting should be avoided because of poor tree quality and general lack of vigor that results. This lack of vigor is considered as a major factor contributing to poor early tree performance in several of the test sites.

Table 4. Correlations coefficient matrix of soil, climate and growth measurements of the regional interstem planting established in 1976.

	Trunk Circ.	Tree Spread	Tree Height	Suckers Tree
Max. temp./yr	.28	.24	.28	<u>.48</u>
Min. temp./yr	.09	—.12	.08	.18
Min. soil temp./yr	—.07	—.39	—.09	—.01
Precip. (May-Sept.)	.11	—.03	—.29	.01
Leaf Nitrogen	—.51	—.25	—.27	—.43
Soil pH	.10	.31	.39	—.13
Lime Test Index	.18	.26	.16	.06
Soil K	.14	.43	.29	—.26
Soil Ca	.25	.05	.22	—.19
Soil Mg	—.10	—.20	—.11	<u>—.67</u>
Soil CEC	—.04	—.28	—.01	—.51
Base Sat. Ca	.24	.20	.26	.13
Base Sat. Mg	—.22	—.17	—.19	<u>—.68</u>
Base Sat. K	.12	.43	.25	—.16
Trunk Circ.	1.00	<u>.87</u>	<u>.91</u>	<u>.71</u>
Tree Spread		1.00	<u>.92</u>	<u>.56</u>
Tree Height			1.00	<u>.60</u>
Suckers/Tree				1.00

Correlation coefficients underlined are significant at the .05% level.

Table 5. Leaf nutrient concentrations in 1980 of interstem apple trees in the regional planting established in 1976.

		% Dry Wt.					ppm						
Cultivar	Rootstock	N	P	K	Ca	Mg	Mn	Fe	B	Cu	Zn	Al	NA
Sturdeespur	MM111	2.38a*	.16ab	.99b	1.20	.30	87a	106	32	2.9	27	121ab	36b
	Antonovka	2.29ab	.18a	1.11a	1.20	.31	83ab	119	34	3.1	27	109b	38b
	Ottawa 11	2.26bc	.17ab	1.07ab	1.36	.28	70bc	130	33	3.6	25	106b	48a
Empire	MM111	2.25bc	.16b	.99b	1.14	.30	89a	112	35	3.0	29	128a	32bc
	Antonovka	2.16c	.16b	1.06ab	1.16	.29	66c	109	32	2.5	23	135a	32bc
	Ottawa 11	2.22bc	.17ab	1.10a	1.26	.29	69bc	88	30	2.7	23	128a	28c

*Means in columns without a letter in common are statistically different (Duncan's Multiple Range p = .05).

Current Status and Recent Trends in Florida Citrus Scion Cultivars

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Additional index words: variety, orange, grapefruit, tangerine, tangelo, lime, lemon.

ABSTRACT

The major citrus scion cultivars in Florida are listed by quantity and relative age as of January 1980. The most important type of citrus is the sweet orange, followed by grapefruit. Florida produces 79% of the U.S. orange crop and 74% of the grapefruit crop. Ninety-four percent of the orange crop and 63% of the grapefruit crop is processed, and the remainder is marketed fresh. The number of citrus trees in Florida declined steadily from the record high in 1969 until the 1978-79 reporting period, when the number increased. Florida now has more grapefruit trees than in 1969 but substantially fewer orange trees. These orange and grapefruit trees produce more fruit per acre than similar trees in California, Texas, or Arizona. During 1978-79 the number of Temple, tangelo, and tangerine trees declined. In spite of the decrease in numbers of trees, Florida growers harvested a record crop of 12.4 million tons of citrus in the 1979-80 season.

The commercially important cultivars in any citrus production area vary with climate, soils, marketing methods, and other factors. The purpose of this report is to list major scion cultivars by quantity and relative age in Florida. The number of trees is the most useful comparison, because the average number of trees per acre varies with the cultivar. Trees are divided into four age groups. In Florida, citrus trees 1-4 years old are considered nonbearing. The latest tree inventory was completed by January 1980 (1). Data in this paper were calculated from this tree inventory and the 1980 citrus summary (2). A similar paper was recently published with older data for Florida and Texas (3).

The most important type of citrus in Florida is the sweet orange (*Citrus sinensis* (L.) Osbeck, which comprised 73.6% of the total trees. The major Florida orange cultivars are shown in Table 1. Hamlin, Parson Brown, and navels are considered early oranges (15 million trees or 181,311 acres). The number of Hamlin trees has increased by 433,000 during the past 2 years.

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