Cultivar and Interstem Effect on Apple Rootstock Sprouting and Control with NAA[1]

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The occurrence of sprouts at or below the soil line in apple plantings is commonly observed. Sprouts, if not contained, interfere with cultural practices and may dominate growth of size controlled trees.

A series of six apple cultivars each on five interstems[3] planted in 1971 at Fayetteville, Arkansas, provided an excellent base for studying sprouting and the use of napthaleneacetic acid (NAA) to control this undesirable characteristic. The trees were propagated on French crab seedling rootstocks with a K-14 trunk section and an interstem. The interstem pieces were either M.27 or one of a "C"-series, i.e., clones selected from open pollinated Clark dwarf (EM VIII) seedlings. Each cultivar interstem combination was replicated four times. Trees were planted with the base of the K-14 trunk just below the soil surface. They were given minimal annual dormant pruning, yearly fertilization and were grown under trickle irrigation in a pre-emergence herbicide treated band.

Sprouts develop from both adventitious and dormant buds. In the apple, the buds are rarely adventitious having been formed in the stock's leaf axils and remaining in an indefinitely latent condition (7). Adventitious buds, by contrast, usually form from callus tissue around wounds (3). As long as the tree is in a physiological condition in which apical dominance prevails, the axillary buds remain dormant. Apical meristems with a high metabolic activity serve as strong sinks for IAA and root produced cytokinins (5). When this condition exists, formation of vascular connections to axillary buds is inhibited. This blocks transport to them and they remain dormant (2). If this physiological balance is altered the dormant buds start to grow as sprouts. High light intensity and excess nitrogen may possibly alter this balance (8).

This research did not investigate the physiological factors affecting sprouting. It did provide data on scion cultivar and interstem effects on rootstock sprouting.

During the two seasons after planting, sprouts were observed on the interstem piece, most frequently on M.27, and the K-14 trunk. These sprouts were few in number, randomly found with regard to cultivar and non-recurring after the third growing season when pruned at their source. Sprouts from the K-14 trunk section below the soil line were easily identified as their leaf bud break was about two weeks later than those on sprouts originating from the French crab seedling rootstocks. All data presented here is for rootstock sprouts.

Each spring following bud break, sprouts formed the previous season were pruned, counted and weighed. The first NAA treatments were applied in the spring 1974. All sprouts were cut to 2.5 cm stubs and sprayed with a 1% NAA[4] mixture in black paint. This procedure was followed each subsequent spring. The black paint marked the sprout stub and made it possible to determine if recurring sprouts came from new locations or from previously cut and treated stubs. Several subsequent reports have indicated success in apple sprout control with NAA (1, 4, 6).

The average rootstock sprout num-

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[3]Trees supplied by Stark Brothers Nursery, Louisiana, MO 63353.
[4]NAA as Tree Hold was supplied by Amchem Products Co., Ambler, PA.

Table 1. Cultivar Effect On Rootstock Sprouting

Cultivar	Av. no. sprouts/tree[2] produced in						Av. dry wgt. sprouts/tree[2]				% trees sprouting[2]						% sprouts[3] from old stubs
	1971	72	73	74	75	76	1972	73	74	75	1971	72	73	74	75	75	'76
Summerglo	0.8	4.0a[1]	6.6	5.0	6.3a	2.8ab	216a	99a	42	37ab	25	60	70	70	80	75	78
Earliblaze	0.3	2.8ab	7.3	3.4	1.2b	0.8b	81abc	38b	11	6b	15	60	35	40	30	45	100
Jon-a-red	0.2	1.2b	5.5	2.7	3.8ab	2.9ab	60bc	187a	36	47a	20	15	85	75	65	70	93
Starkrimson Del.	0.4	2.6ab	3.7	2.0	1.0b	3.4a	170ab	144a	22	19ab	15	50	50	40	25	65	95
Starkspur Del.	0.3	1.6b	1.8	1.4	0.5b	1.0b	29c	104a	20	5b	25	40	50	55	25	35	87
Earlibrite Del.	0.4	1.3b	4.7	2.6	2.1b	4.1a	63abc	221a	36	22ab	25	35	50	60	70	80	98
		*	ns	ns	**	**	**	**	ns	**							
Ave.	.4	2.3	4.8	2.9	2.5	2.5	103	133	28	73	20	44	57	57	48	61	92

[1]Mean separation in a column by Duncan's Multiple Range Test * = 5%, ** = 1% level.
[2]Based on 20 trees/cultivar.
[3]Sprouts originating from area of previously cut and NAA treated stubs.

Table 2. Interstem Effect On Rootstock Sprouting

Interstem	Av. no. sprouts/tree[2] produced in						Av. dry wgt. sprouts/tree grams				% trees sprouting						% sprouts[3] from old stubs
	1971	72	73	74	75	76	1972	73	74	75	1971	72	73	74	75	76	'76
M-27	1.1	5.9[1]a	6.3a	4.4	3.7a	1.8b	233a	224a	54	23	30	71	75	58	46	58	96
C-6	0.6	1.8g	2.8ab	2.2	2.7ab	3.2ab	105ab	187ab	14	32	8	33	63	46	54	42	88
C-48	0.5	1.7g	7.3a	3.7	3.5ab	3.7a	66ab	233a	45	37	30	42	71	79	58	88	86
C-52	0.0	0.3b	2.3b	2.4	1.9ab	2.0ab	3b	31b	16	18	25	20	33	46	46	63	95
C-57	0.7	2.5b	2.8ab	2.5	0.6b	1.6b	110ab	22b	4	3	8	58	42	54	29	46	92
	ns	**	**	ns	**	**	**	**	ns	ns							
Ave.	.5	2.4	4.3	3.0	2.5	2.5	103	139	27	23	20	45	57	57	41	60	92

[1]Mean separation in a column by Duncan's Multiple Range Test, 1%.
[2]Based on 24 trees/interstem.
[3]Sprouts originating from area of previously cut and NAA treated stubs.

ber per tree and sprout weight as affected by cultivar (Table 1) and interstem (Table 2) was minimal and non significant after the initial growing season, although 20% of the trees had produced sprouts. The sprouting propensity increased four fold, based on sprout count after the 1972 season and 45% of the trees had rootstock sprouts. These values increased again in 1973 at which time sprout number and growth was a definite cultural problem.

A significant differential cultivar effect on sprout number/tree existed in three of six years and persisted after NAA use to control sprouting. 'Summerglo' trees consistently ranked high among cultivars with a high sprout incidence and average weight. 'Starkspur Delicious' rated among those cultivars with the lowest sprouting. There was an increase in percentage of trees with sprouts in time. By 1976, 92% of all trees had produced sprouts; however, only 80% of the 'Earliblaze' trees had sprouts. This cultivar had a low sprouting percentage in any given year. Non-significant negative correlations between yield/tree for each cultivar and average sprouts/tree were found in 1975 and 1976.

Interstem source also affected rootstock sprouting, and significant differences between interstems existed in four of six seasons. In the first five seasons, the most dwarfing M.27 interstems had the highest sprouting rate and produced the largest sprouts based on weight (Table 2). Trees with a C-48 interstem in seasons 2-5 were not different from M.27 interstem trees and during the sixth season they had the most sprouts and sprout weight. Each year the percentage of trees with rootstock sprouts increased. The generally more vigorous C-52 and C-57 interstem trees had less trees with sprouts in a given year; however, 70% of all C-6 interstem trees and 100% of the M-27 and C-48 trees had shown this characteristic through the sixth year. Again, nonsignificant negative correlations between rootstock sprouting and tree yield were found for each interstem.

These data (Table 1 & 2), particularly through 1973, indicate that sprouting is affected by scion cultivar and interstem. NAA was applied to cut stubs in the spring of 1974 and the result was an 80% reduction in sprout size, i.e., weight, along with a diminishing in sprout number/tree, by 50%, in some instances. This containment of sprout size and number has held through three years of NAA treatment. There has not been a marked reduction in the number of trees with suckers. In 1976 92% of the new sprouts developed from stubs of old sprouts, originating 1971-73. This would indicate that most dormant buds on the rootstock had grown out, and that continued sprouting was a consequence of failure to control initial sprouts which now serve as an additional bud source.

Sprout growth in apple orchards is a cultural nuisance and a possible problem source. Its incidence is related to the release of dormant buds on the rootstock when the tree's physiological balance moves away from apical dominance. It appears that scion cultivar and or interstem source may enter into this physiological balance in such a way that sprouting is more common with some cultivars and interstems.

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A Perspective on New England's Compact Apple Tree Industry

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New Englanders have been producing apples for the past 348 years. Today, our six-state-region accounts for just under 5% of the nation's apple supply, the product of some 669 commercial orchards encompassing a little more than 27,000 acres (1). Virtually all the fruit is produced and sold for fresh market consumption.

Within New England, 'McIntosh' is king representing 61% of all apples grown. 'Red Delicious' is second accounting for 17% of the crop followed in order by 'Cortland,' 'Golden Delicious' and 'Macoun.' These five cultivars represent 87% of the total production for the six-state-region. The trend toward 'McIntosh,' "McIntosh-types" (Paulared,' 'Empire,' etc.) and solid blush cultivars should continue because of the advantages due to climate, fruit quality and increasing consumer acceptance.

A revolution is in progress in the New England apple industry. To promote management efficiency, low density orchards of large old trees are being rapidly replaced by smaller trees at closer spacings. This dramatic shift has shown that during the past decade the numbers of standard trees have decreased 12%, and that trees on size-controlling rootstocks have increased 296% (2). Today, dwarf and semi-dwarf trees represent 41% of the total trees of all ages in New England, whereas in 1965, they totalled only 15%. For every ten trees planted today, nine are on size-controlling rootstocks. Averages show it takes about three semi-dwarf trees to replace the yield from one standard tree. Considering the decrease in the number of standard trees and recognizing the great increases in compact tree numbers, New England's apple industry should still maintain its present level of production over the next ten years. Therefore, yield is not the motivating factor behind the change-over to compact trees, but rather the following economic necessities:

1. Consistent production of top quality fruit at reduced costs per bushel.
2. Compact orchards are easier and faster to harvest. This means that growers can rely more on domestic pickers rather than be dependent on the highly-skilled foreign pickers whose availability is always uncertain given politics and the like.
3. Smaller trees can be more efficient and inexpensive to maintain.
4. Encroaching suburbia and high taxes which will limit the availability of new and old orchard sites in the future.

The health of New England's apple industry depends upon maximizing yields of quality fruit and economizing the management of our apple cultivars.

The two rootstocks that are "getting the job done" in New England, to some degree of satisfaction, are 'M.7'

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