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Effect of Initial Heading Height on Branch Development of Four Apple Cultivars[1]

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Abstract

The effect of initial heading height on branch development over the first growing season was evaluated for 'Macspur' (Greenslade selection), 'Cortland,' 'Smoothee Golden Delicious' (Gibson strain), all with an initial trunk caliper of 1.6 cm, and 'Redchief Delicious' (Mercier strain), with an initial trunk caliper of 1.0 cm. All cultivars were evaluated on M.7A rootstock. The trees were headed at 60, 70, 80, or 90 cm above the ground at planting. Heading at 90 cm produced the best branching response in terms of branch number, angle, and total length for 'Macspur,' 'Cortland,' and 'Golden Delicious.' Average branch length was not limiting for these three cultivars at any heading height. In 'Redchief Delicious' average branch length was the limiting characteristic at all heading heights, and was longest when this cultivar was headed at 60 cm.

Introduction

Under current practices in North America, apple trees are usually planted as one-year-old, unbranched whips. It is recommended that these whips be headed (cut back) at planting to encourage shoot growth and begin the development of an efficient branch structure for fruit production (9). Headed trees begin growth sooner after planting than trees not headed (9). In general, as the height of this single, initial heading cut is decreased, fewer branches develop, branch angle becomes wider, and length per branch increases (3, 4, 9). It is important that enough branches with strong, wide crotch angles, and with sufficient length, are produced in the first growing season for selection of initial scaffold branches in subsequent tree training. The development of too few vigorous branches, poor branch placement, or too many branches with narrow crotch angles will seriously impair or delay desirable tree training. In addition, development of total branch length is important because it is related to the total photosynthetic area produced over the first season, and, thus, to the rate of early tree development.

Recommended heading height depends on the specific needs of the training system to be used and the vigor and growth habit of the cultivar-rootstock combination planted (3, 4, 6). The most common training system for apples in North America is the free-standing central leader, but there is considerable variation in recommended heading height. Previously, when cultivars were grown primarily on vigorous seedling rootstocks, no heading or high heading between 100 and 130 cm was recommended (5, 7). With the use of size controlling rootstocks, lower heading heights have been recommended, ranging from 60 to 90 cm (1, 2, 3, 4, 5, 8, 10). For weak trees and strongly spur-type strains, such as spur-type 'Delicious,' heading recommendations range from 50 to 80 cm (1, 3, 5). Because of the marked effects of initial heading height on tree development and because of the range in heading height recommendations, this study was initiated to determine the optimum heading height for four cultivars important to Maine and the northeast.

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Materials and Methods

'Macspur,' 'Cortland,' and 'Golden Delicious' (1.6 cm caliper), and 'Redchief Delicious' (1.0 cm caliper) were planted in 1985 as single whips at 7.6 x 7.6 m, with the graft union at 5 cm above the soil surface. All trees were purchased from the same nursery on M.7A rootstock. The orchard was arranged in 4 single-cultivar blocks, with 9 replications of 4 heading height treatments (60, 70, 80, and 90 cm above the ground) imposed on each cultivar as a randomized complete block design. Heading height treatments were compared within cultivars by analysis of variance, but cultivars were not randomized and so could not be compared statistically. At the end of the first growing season, number, height from the ground, and angle from the trunk of primary branches, total length of primary and secondary branches, and trunk circumference at 15 cm above the ground was measured for each tree. Shoots less than 2 cm in length were not considered as branches.

Branching response over the first growing season to the heading height treatments was examined in two ways. First, whole-tree branch development was evaluated as an indication of the above-ground biological response to heading height. Secondly, branch development in the useful branching zone of the trunk was evaluated as the important horticultural response. Before the first dormant period, branches below 40 cm must be removed for the placement of mouse guards and to prevent the development of scaffold branches too near the ground. Also, branches within 10 cm of the apical branch selected to be the leader must be removed, in order to establish a central leader tree form. Thus, the effect of heading height on branch development was evaluated between these two useful limits (useful branching zone).

Results and Discussion

Trunk cross-sectional-area at the end of the first growing season was not affected by heading height for any cultivar (data not presented). However, while cultivars could not be compared statistically, large differences stand out among cultivars in trunk and shoot growth over the first season. In particular, 'Redchief Delicious' increased markedly in trunk cross-sectional-area (Table 1), but developed little total branch length (Table 2), compared to the other cultivars. This pattern might be expected for a spur-type cultivar. However, 'Macspur,' also a spur-type cultivar, was at the opposite end of the range in both parameters of growth, increasing very little in trunk cross-sectional-area but developing considerably in total branch length (Table 1, 2). 'Cortland' and 'Golden Delicious' developed equally in both trunk cross-sectional area and branch length, without the marked partitioning of growth evident in the other two cultivars.

Branch number decreased as heading height decreased for 'Cortland' and 'Golden Delicious,' but was unaffected by heading height in 'Macspur.' This was true over the whole tree (Table 2) and in the useful branching zone (Table 3). The response of branch number to heading height in 'Redchief Delicious' was quadratic (Table 2, 3), with more branches produced when headed at 70 or 80 cm

Table 1. Increase in trunk growth over the first growing season for four apple cultivars on M.7A rootstock.

Cultivar	Increase in trunk cross-sectional-area[z]	
	Absolute (cm^2)	Relative (%)
'Macspur'	0.18	9
'Cortland'	0.33	17
'Golden Delicious'	0.52	26
'Redchief Delicious'	0.42	59

[z]No significant differences in trunk growth among heading height treatments within each cultivar.

Table 2. Effect of initial heading height on whole-tree branch development over the first growing season of four apple cultivars on M.7A rootstock.[z]

Cultivar	Heading height (cm)	Number of primary branches	Average primary branch angle (degrees)	Branch length	
				Total[y] (cm)	Average (cm)
'Macspur'	90	6.2	42	220	38.2
	80	5.9	43	291	34.9
	70	6.0	40	165	30.2
	60	6.1	43	168	28.6
	linear	ns[x]	ns	ns	ns
	quadratic	ns	ns	ns	ns
	cubic	ns	ns	ns	ns
'Cortland'	90	7.8	38	219	27.1
	80	8.0	34	228	30.3
	70	6.1	29	180	29.5
	60	3.1	22	137	43.8
	linear	*	*	*	*
	quadratic	*	ns	ns	*
	cubic	ns	ns	ns	*
'Golden Delicious'	90	9.8	40	229	23.7
	80	7.8	35	209	27.4
	70	7.3	40	200	28.7
	60	6.7	43	172	25.5
	linear	*	ns	ns	ns
	quadratic	ns	ns	ns	ns
	cubic	ns	ns	ns	ns
'Redchief Delicious'	90	2.0	36	11	5.0
	80	4.6	38	27	5.0
	70	4.6	38	33	6.7
	60	3.4	38	38	10.7
	linear	ns	ns	*	*
	quadratic	*	ns	ns	ns
	cubic	ns	ns	ns	ns

[z]Data are restricted to branches over 2 cm in length.
[y]Primary and secondary branches.
[x]Trends over heading height treatments determined by orthogonal contrasts: significant at 5% level (*), not significant (ns).

Table 3. Effect of initial heading height on development of branches within the useful branching zone for four apple cultivars on M.7A rootstock.[z]

Cultivar	Heading height (cm)	Number of primary branches	Average primary branch angle (degrees)	Branch length	
				Total[y] (cm)	Average (cm)
'Macspur'	90	4.7	41	160	37.0
	80	4.0	36	147	41.6
	70	3.8	40	100	29.3
	60	3.2	41	106	35.7
	linear	ns[x]	ns	*	ns
	quadratic	ns	ns	ns	ns
	cubic	ns	ns	ns	ns
'Cortland'	90	6.3	41	162	24.9
	80	5.7	37	157	28.8
	70	3.9	34	111	29.1
	60	1.4	14	76	45.2
	linear	*	*	*	*
	quadratic	ns	*	ns	*
	cubic	ns	ns	ns	*
'Golden Delicious'	90	7.1	42	165	23.5
	80	5.1	37	130	26.8
	70	4.6	43	130	29.0
	60	3.3	44	102	29.7
	linear	*	ns	*	ns
	quadratic	ns	ns	ns	ns
	cubic	ns	ns	ns	ns
'Redchief Delicious'	90	1.7	37	9	4.8
	80	3.1	38	20	5.5
	70	2.9	37	23	8.0
	60	2.0	35	21	10.7
	linear	ns	ns	ns	*
	quadratic	*	ns	ns	ns
	cubic	ns	ns	ns	ns

[z]Data are restricted to branches over 2 cm in length. The useful trunk zone for branch development is between 40 cm from the ground and 10 cm below the apical branch selected as central leader.
[y]Primary and secondary branches.
[x]Trends over heading height treatments determined by orthogonal contrasts: significant at 5% level (*), not significant (ns).

than when headed at 60 or 90 cm. Typical of spur-type 'Delicious' strains, all heading heights induced fewer branches in 'Redchief Delicious' than in the other cultivars, with the exception of 'Cortland' headed at 60 cm (Table 2, 3). Average branch angle of 'Cortland' trees decreased linearly with decrease in heading height, but was unaffected by heading height in the other cultivars (Table 2, 3).

Whole-tree total branch length decreased linearly with decreased heading height in 'Cortland,' but was not affected by heading height in 'Macspur' and 'Golden Delicious' (Table 2). In the useful branching zone, total branch length decreased linearly with decrease in heading height of 'Macspur,' 'Cortland,' and 'Golden Delicious' (Table 3). Average branch length of 'Cortland' increased with decrease in heading height, opposite to the decrease in branch number and total branch length with decrease in heading height (Table 2, 3). Heading height did not affect average branch length of 'Macspur' or 'Golden Delicious' (Table 2, 3). However, average branch length for 'Macspur,' 'Cortland,' and 'Golden Delicious' was sufficient at all heading heights to allow selection of good initial scaffolds, and so was less limiting in these trees than was branch number and total branch length for the selection of scaffolds with good radial and axial distribution along the trunk and the development of maximum photosynthetic surface.

In contrast to the other 3 cultivars, total branch length of 'Redchief Delicious' increased linearly over the whole tree with decrease in heading height (Table 2), but was not affected by heading height in the useful branching zone (Table 3). Therefore, whole-tree photosynthetic surface of 'Redchief Delicious' would be expected to be greatest among these treatments when headed at 60 cm. Average branch length of 'Redchief Delicious' also increased linearly over the whole tree, as well as in the useful branching zone (Table 2, 3). However, 'Redchief Delicious' produced much shorter average and total branch length at all heading heights than the other 3 cultivars, and average branch length was particularly limiting (Table 2, 3). Heading 'Redchief Delicious' at 60 cm was required to achieve an average branch length of 10.7 cm in the useful branching zone (Table 3) and over the whole tree (Table 2). It has been reported that branches with sufficient vigor to be considered in scaffold selection develop within 8 cm of the heading cut for spur-type strains of 'Delicious' (3). Thus, heading 'Redchief Delicious' much below 60 cm would result in the formation of scaffold branches below 50 cm from the ground, the lower desirable limit of scaffold height in a central leader system. The need to develop total and average branch length in 'Redchief Delicious' by heading at 60 cm was more important than the fact that maximum branch number in this cultivar was obtained at heading heights of 70 and 80 cm (Table 2, 3). Results of this study suggest that strongly growing cultivars, such as 'Macspur,' 'Cortland,' and 'Golden Delicious,' with large initial trunk caliper, develop the best branch structure for a central leader system when headed at 90 cm. Strongly spur type cultivars, such as 'Redchief Delicious,' with small initial caliper, should be headed at 60 cm to develop a central leader system.

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'Perron's Red' Primocane Raspberry

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Origin

'Perron Red' is a cross of 'Pathfinder' as pollen plant and 'Zeva Herbsternte' as seed plant. Seedling selected in 1977 inherited best quality of both parent plants which are primocane fruiting vigorous stems and growth, good size and taste of fruits and hardiness. Plants have wide adaptation and good resistance to diseases and insects.

Growth Characteristics

'Perron Red' is a vigorous primocane fruiting raspberry. Canes do not need to be supported, lateral branches are growing at height of 18 inches (45 cm) or lower. Total height reaches 5 feet. (150 cm).

Fruit Characteristics

First fruits are produced in July on lateral branches. Fruiting is increasing during August to reach top production of berries during September persisting till November. Fruits are conical 35 mm long by 25 mm wide. Laboratory analyses have given high sugar and pectin contents. Fruits are excellent for fresh consumption, freezing, jam, jelly and syrup.

Uses

'Perron Red' is best for roadside markets, pick your owns and home gardens.

Maintenance

'Perron Red' is a primocane fruiting type and may be pruned back to ground level late fall. If earlier production is desirable, preserve some strong one year old canes and prune them back to 30 inches (75 cm) 'Perron Red' is bearing plenty of huge fruits during long fruiting season and should therefore be fertilized twice a year in early spring and mid-summer. Eliminate readily all unnecessary suckering.

Release

Tissue cultured plants are available for distribution to Experimental farm and University trial garden in U.S.A. Tests have to be made with other primocane cultivars. Plants for such test on official demands may be obtained from:

Congdon and Weller
Wholesale Nursery Inc.
Mile Block Road
North Collins, N.Y. 14111
U.S.A.

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