Summer Pruning Affects Yield and Improves Fruit Quality of ‘McIntosh’ Apples

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Abstract. The effects of summer pruning on the yield and quality of apples (Malus domestica Borkh.) from mature ‘Rogers McIntosh’/M.7 trees were assessed in 1986-88. Summer pruning from 1 July through 1 Sept. enhanced red coloring and increased the percentage of the crop graded U.S. Extra Fancy. Fruit weight was not altered by summer pruning. Total yield was reduced by summer pruning only in 1 year, however, in no year was the harvested yield reduced. The portion of the crop that was picked in the first harvest was increased by summer pruning. Dormant-pruning time was decreased by summer pruning, and the total time required for pruning was increased only 1 of the 2 years where it was measured. Summer pruning and daminozide treatment significantly increased the estimated net returns.

‘McIntosh’ accounts for 58% of the New England apple heritage (Autio, 1989). Growers must wait for adequate color development before the beginning of ‘McIntosh’ harvest, since the U.S. Extra Fancy grade requires 50% of the surface to be a red that is sufficiently intense to be characteristic of the cultivar. Consequently, it is difficult to pick the entire crop before a significant portion abscises. Additionally, since all ‘McIntosh’ fruit do not color simultaneously, multiple harvests are required. ‘McIntosh’ growers have relied heavily on daminozide for preharvest abscission control and delay of ripening. Since daminozide is no longer available, other techniques must be used to allow growers to harvest a large portion of their crop meeting the Extra Fancy Grade.

Summer pruning is one horticultural practice that may assist growers in solving this difficult problem. Vincent (1917), Preston and Perring (1974), Stiles (1980), Lord and Greene (1982), Marini and Barden (1982), and Morgan et al. (1984) all showed increases in fruit redness as a result of summer pruning. This increase in red pigment was attributed to increased light penetration into the fruit-bearing portion of the tree canopy. Increasing redness by summer pruning may allow earlier harvest of ‘McIntosh’ as well as increase the portion of the crop reaching the Extra Fancy grade before abscission. However, decreases in fruit size have also been reported in some studies (Stiles, 1981; Marini and Barden, 1982; Myers and Ferree, 1983; Greene and Lord, 1983).

The objective of this study was to determine if summer pruning would enhance red pigmentation, thus allowing earlier harvest of Extra Fancy fruit and a consequent reduction in preharvest drop. Additionally, we assessed the economic impacts of summer pruning.

Materials and Methods

All trees used in these experiments were trained to a central leader. Limb renewal in the upper one-third of the canopy was done during the dormant season to improve light penetration. Summer pruning consisted of thinning cuts made throughout the tree. Strong, upright branches, watersprouts, and shade-causing, hanging branches were removed. Horizontal branches were removed only if they caused significant shading to fruit below them. No branch with a diameter >2 cm was removed. No heading cuts were used, and, in general, cuts were not made in close proximity to fruit.

One summer pruning (Expt. 1). In 1986, 10 two-tree blocks (replications) of 23-year-old ‘Rogers McIntosh’/M.7 trees were selected at the Univ. of Massachusetts Horticultural Research Center (HRC, Belchertown). One tree in each block was pruned on 21 Aug. A 30-fruit sample was taken and weighed on 9 Sept. Fifteen fruit were harvested randomly from the periphery of each tree in each block and 15 randomly from the interior. The percentage of red surface was assessed for each fruit, and the percentage of the sample making the Extra Fancy grade was determined. Commercial harvest began on 10 Sept. A commercial harvest crew picked the fruit from each tree, with the same individual harvesting both trees in a block. The crew was instructed to harvest only Extra Fancy fruit. A second harvest was made on 25 Sept. Yield for each harvest was recorded. All abscised fruit were collected after each harvest, and the “dropped” yield was recorded. The time required to prune each tree in the dormant season was recorded.

Pruning dates (Expt. 2a). In 1987, 15 six-tree blocks (replications) of 24-year-old ‘Rogers McIntosh’/M.7 trees were selected at the HRC. A single tree in each block was pruned on...
Table 1. Effects of summer pruning on the fruit quality, fruit weight, yield, and pruning time of ‘Rogers McIntosh’/M.7 trees (1986-88; Expt. 1-2b).

| Summer pruning treatment | Red surface (%) | Extra Fancy (%) | Fruit wt (g) | Total yield per tree (kg) | Harvested yield per tree (kg) | Portion of total yield (%) | Pruning time per tree (min) |
|--------------------------|----------------|----------------|-------------|--------------------------|-----------------------------|---------------------------|-----------------------------|
|                          | 1986           | 1987           | 1988*       |                          |                             |                           |                             |
| Control                  | 49             | 57             | 56          | 1986                     | 240                         | 168                       | 59                          | 17                          |
| 21 Aug.                  | 42             | 72             | 61          | 1987                     | 248                         | 201                       | 134                         | 11                          |
| Significance             |                |                |             |                          |                             |                           |                             |                             |
|                          | 1986           | 1987           | 1988*       |                          |                             |                           |                             |
| Control                  | 52             | 61             | 61          | 1986                     | 146                         | 206                       | 43                          | 18                          |
| 1 July                   | 44             | 71             | 62          | 1987                     | 147                         | 202                       | 53                          | 11                          |
| 15 July                  | 76             | 76             | 64          | 1988*                    | 145                         | 183                       | 55                          | 16                          |
| 4 Aug.                   | 150            | 150            | 64          | 1986                     | 287                         | 191                       | 57                          | 23                          |
| 14 Aug.                  | 146            | 89             | 64          | 1987                     | 293                         | 193                       | 54                          | 25                          |
| 1 Sept.                  | 144            | 73             | 61          | 1988*                    | 308                         | 198                       | 55                          | 26                          |
| Significance             | **             | **             | NS          | 1986                     | **                          | ns                         | **                          |                             |
| Control vs. pruning      |                |                |             |                          |                             |                           |                             |                             |
| Among pruning            | NS             | NS             | ---         |                          |                             |                           | ---                         |                             |
|                          | 1988*          |                |             |                          |                             |                           |                             |                             |
| Control                  | 56             | 61             | 61          | 1986                     | 163                         | 223                       | 149                         | 21                          |
| 1 July                   | 61             | 82             | 61          | 1987                     | 163                         | 181                       | 142                         | 14                          |
| 15 July                  | 61             | 73             | 61          | 1988*                    | 158                         | 163                       | 119                         | 14                          |
| 1 Aug.                   | 68             | 92             | 68          | 1986                     | 160                         | 161                       | 123                         | 13                          |
| 15 Aug.                  | 69             | 91             | 69          | 1987                     | 164                         | 166                       | 123                         | 17                          |
| 1 Sept.                  | 67             | 92             | 67          | 1988*                    | 164                         | 163                       | 127                         | 12                          |
| Significance             | **             | **             | NS          | 1986                     | **                          | NS                         | **                          |                             |
| Control vs. pruning      |                |                |             |                          |                             |                           |                             |                             |
| Among pruning            | 1**            | 1**            | NS          | 1986                     | 1**                         | NS                         | 1**                         |                             |

*Values for red surface are means of 300 observations, all others are means of 10.
*Values for red surface are means of 450 observations, all others are means of 15.
*ns: Significant linear or quadratic component, respectively.
*Values for red surface are means of 240 observations, all others are means of eight.
*Significant at \( P = 0.01, 0.05, \) or nonsignificant, respectively.

Results and Discussion

In all years the percentage of red surface and the percentage of a sample making the Extra Fancy grade were significantly increased by summer pruning (Table 1). In 1987, the five dates of summer pruning (1 July-1 Sept.) gave similar responses. In
Effects of summer pruning and growth regulator application on the yield of and yield per tree (kg) | Harvested yield per tree (kg) | Portion of total yield (%) | Pruning time per tree (min) |
|--------------------------|-----------------------------|---------------------------|--------------------------|
| Control | 185 a | 119 b | 55 a | 34 a | 10 a | 18 b | 28 a |
| Summer-pruned | | | | | | | |
| Control | 191 a | 125 b | 48 a | 33 a | 10 a | 22 a | 32 a |
| NAA | 204 a | 142 a | 53 a | 29 a | 10 a | 18 b | 28 a |

Table 2. Effects of summer pruning and growth regulator application on the yield of and yield per tree for ‘Rogers McIntosh’/M.7 trees (1988; Expt. 3).\(^2\)

Table 3. Effects of summer pruning and growth regulator application on the quality and grade distribution of fruit from ‘Rogers McIntosh’/M.7 trees and the estimated net return of the treatments (1988; Expt. 3).\(^2\)

1988, the response became greater as summer pruning was performed closer to harvest. The apparent discrepancy between 1987 and 1988 data is related to the amount of regrowth that resulted from the summer pruning treatments. In 1987, terminal buds hardened early, so very little regrowth occurred from the early treatments, whereas, in 1988, bud hardening occurred later and enough regrowth occurred from the early treatments to reduce the light penetration to the fruit and thus coloring.

Fruit weight was not affected by summer pruning, even when pruning was done as early as 1 July (Tables 1 and 3). Summer pruning has been shown to reduce fruit size (Stiles, 1981; Marini and Barden, 1982; Myers and Ferree, 1983; Greene and Lord, 1983), but the effect has not been consistent. Greene and Lord (1983) found that summer pruning decreased the size of ‘Cortland’ fruit, but not of ‘Delicious’. Morgan et al. (1984) found that only early season summer pruning reduced the size of ‘Gala’ fruit. Miller (1982) found no effect of summer pruning on the size of ‘Delicious’ fruit. These different results may be partially explained by differences in the location and severity of the summer-pruning treatment. Greene and Lord (1983) suggested that, as the severity of pruning increased or the distance between the cut and fruit decreased, the potential for a size reduction is enhanced. In our study, cuts were not made close to the fruit, and the intensity of the summer pruning was not severe.

Yield per tree was reduced by summer pruning only in 1988 (Table 2). This response was attributed to loss of some fruit during summer pruning and to the removal of some fruiting, hanging branches that were shaded. However, in no year was the quantity of harvested fruit reduced. In all years, the percentage of the yield harvestable during the first picking was increased significantly by summer pruning (Tables 1 and 2). In 1986 and 1988, summer pruning reduced the loss of fruit to drop by increasing the percent of the crop that was harvested before drop became severe. A direct effect of summer pruning on drop also may explain some of this reduction in loss. Marini and Barden (1982) showed that summer pruning decreased fruit abscission for ‘Delicious’ and ‘Stayman’ trees.

Although summer pruning represents an additional labor input, in all years it significantly reduced the time required to dormant-prune (Tables 1 and 2). Summer pruning increased total pruning time by an average of 30% in 1987, but not in 1988 (Tables 1 and 2).

Summer pruning did not affect flesh firmness in 1988; however, daminozide produced increased firmness for both harvest dates, while NAA reduced firmness (Table 3).

Summer pruning significantly increased the percentage of the crop in the Extra Fancy grade and significantly reduced that in the Fancy, No. 1, and processing grades (Table 3). Fruit from...
the first harvest date showed no differences among the chemical treatments, but fruit treated with NAA from the second harvest date were more commonly graded into the processing category because of the excessive bruising of these softer fruit.

Summer pruning significantly increased estimated net return, as did the use of daminozide (Table 3). Summer pruning and daminozide increased net returns to a similar degree, 13% and 15%, respectively; however, it should be noted that daminozide did not control drop effectively in these trees in 1988. Daminozide may be expected to provide more economic benefit in years when it reduces drop significantly.

We have shown that summer pruning can significantly improve fruit coloring, allow more fruit to be harvested earlier, and reduce the losses to preharvest abscission. Pruning can be performed from 1 July to 1 Sept. in the climate of New England and in similar areas with similar benefits. This technique provides one means whereby apple growers can reduce the dependence on daminozide for ‘McIntosh’ production.

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