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Results of Some Young Apple Tree Pruning Experiments

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Results of Some Young Apple Tree Pruning Experiments

T. J. TALBERT

Those best informed on pruning have during the past fifteen to twenty years advocated light pruning. This has been true because a great mass of experimental evidence from many stations has shown that the so-called conventional or heavy pruning is unprofitable. The change from heavy to light pruning has resulted from a study of the performance records of the best orchards. This study has convinced most growers that, after all, the best place to study pruning and training systems is in the most productive orchards, and that the varietal characteristics of the trees must be carefully considered among the factors determining the amount and kind of pruning and training to be given.

REVIEW OF PREVIOUS WORK

Alderman and Auchter (1)* of West Virginia found that light pruning tended to induce early bearing and heavy pruning seemed to retard bearing. Heavy annual dormant pruning gave stronger terminal growth than lighter pruning and severe pruning appeared to be beneficial for the first two or three years, after which growth was suppressed and dwarfed by the heavy cutting.

Bedford and Pickering (2) in England report that pruning young apple trees reduced both size and yields. Hard pruning had the greatest effect on these reductions and moderate pruning was intermediate between heavy pruning and no pruning. By placing the value of the crop from moderately pruned trees at 100 during the first ten years, it was found that the value of the crop from unpruned trees was 158 while that from the heavily pruned trees was only 49.

For New York, Chandler (3) believes that the pruning required for young trees to assume any form different from that to which they would naturally grow reduces both the growth and amount of fruit they will bear in early life. Moreover, fruiting dwarfs the tree to a greater extent than does moderate pruning. Consequently after a few years of fruiting, unpruned trees may be no larger than trees receiving a moderate amount of pruning.

In Delaware, Greve (4) studied a comparison of pruned and unpruned apple trees during the first ten years in the orchard. He found that the trunk circumferences of the unpruned trees were

*Numerals refer to "Literature Cited," Page 23.

larger than those of the pruned trees. The pruned trees, however, in most cases made longer terminal growths than did the unpruned trees. When all the varieties were considered together the unpruned trees greatly outyielded the pruned trees. The size and color was maintained on the unpruned trees of Delicious, Stayman, and Rome, while unpruned Transparent and Grimes trees produced fruit noticeably smaller than that from the pruned trees.

Horsfall (5) suggests that a large ratio of trunk to limb diameter appears to be positively correlated in some way with wide crotches. Moreover, the comparison of orchards grown from budded trees with those propagated other ways gives clear evidence that few if any lasting harmful effects follow the cutting back treatment. In cut-back Jonathans, young scaffold limbs start out in the axils of the leaves and grow almost vertically upward for about an inch. Something in the subsequent growth, however, turns the longitudinal limb axis from the vertical toward the horizontal position as these same limbs at the close of growing season may form crotch angles of nearly ninety degrees.

Horsfall and Vinson (6) have shown that the resistance of crotch tissues to low temperatures seems to be correlated with the width of the crotch angle. It was found that tissues in crotches of wide angles appear to mature earlier and hence were less frequently found injured by cold.

Horsfall and Vinson (7) also believe that the wide angles in the young scaffold branch of cut-back trees are due to the rapid enlargement of the trunk which forces a change of angle from narrow to wide while the tissues of the latter are yet too soft and plastic to resist the growth pressure. Moreover, lower lateral buds on a one-year-old tree lie with their axes far from the vertical; consequently scaffolds originating from such buds usually grow at a wide angle.

MacDaniels (8) concludes that a scaffold branch forming a narrow angle at the point of union with the tree trunk is structurally weak, due to the inclusion of bark in the narrow crotch between the branch and the trunk, and to failure of contiguous tissues of the trunk and branch to unite and grow together. In wide angled branches, however, he found that a woody structure forms in the crotch, uniting crotch tissues of the branch with adjacent tissues of the trunk. Branches with wide angles are strong and capable of bearing heavy loads of fruit and resisting storms without breaking while limbs forming narrow angles with the trunk are in danger of breaking at the crotch under the weight of even a moderate crop.

Oskamp (9) of New York considered the effect of pruning apple trees at planting time. He concludes that the more severe the pruning, the less is the weight of the tree at the end of the first year, the longer and heavier is the terminal growth produced, and the fewer are the growing points. By the end of the third and fourth year, the pruning effect seems to have become negligible except possibly in the case of trees cut to a whip. However, there is a positive correlation between the weight of the tree at planting time and its weight four years later.

Talbert (10), reported that young trees cut back to short stumps near the ground produced lower, better placed branches with wider angles than untreated trees. He also found that the cut-back trees were nearly as large after four years' growth as check trees.

Verner (11) reports that wide crotch angles result from the action of a plant hormone formed in the growing points of the young tree. When passed downward through the phloem, its action inclines the direction of growth of the shoot towards a horizontal position. Furthermore, when indole butyric acid was permitted to diffuse slowly and over a long period into the cut terminal portions of whips that had been headed back to about 30 inches while dormant, abnormally wide crotch angles were developed throughout the entire tree.

Part I. Investigations in Cutting Back

CUTTING BACK* YOUNG APPLE TREES TO SHORT STUMPS NEAR THE GROUND

It is generally known that nurserymen often cut back young apple trees to short stumps after they have grown in the nursery rows one or two years. The resulting trees consist of one-year-old tops and two or three-year-old roots. When so treated they may show equally as much or more growth and vigor than uncut-back trees.

The need for more definite information regarding the period of time and results from cutting back injured apple trees in the orchard was brought forcibly to the attention of the Missouri Agricultural Experiment Station in January, 1919. A commercial apple grower of southwest Missouri reported that about 300 young apple trees planted as one-year-old trees the previous spring had been girdled above the wraps by rabbits. The wounds of part of the trees were painted

*In pruning literature, the term, "cutting-back", generally refers to rather severe pruning or shortening back of the branches of the tree top. For the description of the experiments which follow, however, cutting-back in every instance means the severing or cutting of the young tree trunk near the ground and above the graft union of stock and scion.

with grafting wax, others with paint, and some were untreated. All the injured trees were allowed to stand until growth started in the spring. An examination at that time showed that the injury was severe above the wraps. Moreover, considering the age of the trees and the severity of the injury, bridge grafting was believed to be impractical. Consequently, 280 apple trees of the previous spring's planting were cut back on March 25 to stumps from 4 to 6 inches high. The varieties consisted of York, Rome, Grimes and Winesap.

After three seasons' growth the sprouts arising from the cut-back trees had made almost as large tops as the trees which had not been cut back. Of the 280 trees only two failed to produce satisfactory sprouts for the growth of trees. The most significant difference noted between the cut-back and untreated trees was the manner of branching of the former and the height of the limbs from the ground. The main or scaffold branches in the cut-back trees were observed to start much nearer the ground. In most instances well-placed branches started at heights from 14 to 18 inches, and spread out at a much wider angle than the branches of trees not cut back. The treated trees also had the branches better placed up and down the main stem of the tree trunk, enabling the pruner to select without difficulty the branches desired for a well-shaped and well-balanced head.

It was also observed that the cut-back trees appeared to be much more vigorous, having brighter colored bark, larger leaves, and in general they presented unmistakable evidence of greater vitality than uncut-back trees. There were no indications of stunting or poor growth with the cut-back trees, while occasionally this was true with the untreated trees.

The only trunk difference observed between the treated and untreated trees was that the former usually showed a little bend or crook about 4 or 5 inches above the ground at the point from which the sprout arose from the stump. This slight curve at the base of the trunk disappeared, however, after 4 or 5 years of growth. An examination during the growing season, nine years after planting, showed that the cut-backs were as large as the average uncut-back trees, and that the branches were much lower, better placed, and gave wider angles. Both check and treated trees received light annual top prunings. Little fruit was borne on any of the trees that year, but the cut-backs appeared to have as many fruits as the untreated trees.

YOUNG TREES CUT BACK AFTER HAIL STORM INJURY

On May 9, 1923, one of the most serious hail storms known to southwest Missouri occurred near Neosho. In all cases where orchards were hit, practically all of the bark on the south and west sides of the trees was either removed or seriously bruised and injured. In order to save the trees, it was the general opinion of the growers that all young apple trees from one to four years of age should be cut back to short stumps at once.

After representatives of the college had examined orchards throughout the area damaged by the hail storm, they suggested that the cutting back of the young trees be discontinued. At that period, May 12, the trees had made practically all the shoot growth that would normally occur during the season. It was thought that unless weather conditions were very favorable many of the cut-backs would make no growth. Furthermore, good cultivation at once was suggested, and where the soil was poor, that a light application of nitrate of soda be applied to assist the trees in developing quickly new growth to cover the wounds made by the hail. Spraying with lime-sulfur or Bordeaux was advised to prevent at least to some extent the development of diseases in the wounds of the trees.

As several growers had already cut back their young trees to stumps near the ground, a test or experiment had already been set up. In the orchard of Mrs. Bessie Mathis near Neosho, about 180 trees were cut back, while about the same number was left untreated. About an equal number of the following varieties was found: Jonathan, Grimes Golden, and Winesap. The trees in this orchard were in the third season of growth at the time of injury and it is interesting to note that very few of the trees which were cut back on May 12 produced sprouts during the remainder of the growing season. At the close of the growing period, a count showed that 90% of the cut-back trees were lost. The untreated trees healed their wounds and 85% lived and were considered satisfactory, although they still bore the hail marks and indications of severe injury the following year.

In this orchard as well as in others which were damaged by the hail, severe pruning of the tree tops soon after the injury was tried as an invigorating process on plots of representative trees. The heavily pruned trees did not make as much leaf growth as the unpruned ones, and there was a marked difference in the time required for the healing of the hail wounds. The unpruned trees healed nearly all of their wounds during the remainder of the growing season and appeared to recover from the injury rapidly

while the pruned trees healed slightly more than half their wounds and were comparatively slow in recovery from the injury. The difference in growth and recovery was no doubt due to the fact that the unpruned trees developed considerably more leaf surface at this critical period. This enabled them to manufacture and utilize larger quantities of food materials more readily and efficiently in wound healing.

EXPERIMENTAL WORK STARTED IN 1924 AND CONTINUED TO 1939 INCLUSIVE

In the spring of 1924, it was deemed advisable to begin cutting back experiments with young apple trees. The objective was to determine the best time for cutting back trees to ascertain the effect upon the habit of growth, and to note what influence, if any, the operation might have on time of coming into bearing. The varieties employed were Jonathan, Grimes Golden, Golden Delicious, Delicious, Winesap, Stayman Winesap, Rome Beauty, and Gano.

This later work confirmed the earlier investigations and showed that almost invariably the cut-back trees produced lower and better placed branches with wider angles than the untreated ones. In about 4 or 5 years after being cut back, the trees are practically as large, and in some cases larger, and have as great a spread of branches as the untreated ones. See Figures 1, 2, 3 and 4.

Moreover, the study seems to indicate that for one and two-year-old apple trees, it is generally best to cut them back to stubs or stumps about 4 inches high. A sufficient number of sprouts usually arise from the stump to give a choice as to position and vigor. The sprout which best meets the requirements is left and all the others are removed. It is usually advisable to start thinning or making sprout selections and removals when the growth is about 6 to 8 inches high. The largest and best placed shoot should be saved and all the rest removed close to the stump. The shoots or sprouts arising from the stumps first grow outward and then upward, forming a slight bend or curve in the trunk.

It was also observed that there was a tendency for the sprout or shoot arising from stumps 8 to 10 inches high to produce a long straight whip-like growth often without limbs or side branches. This type of growth was common enough on all the standard varieties to make it more or less significant, and was much less noticeable when the stumps were short, 4 or 5 inches high. There is also less danger of breaking the sprouts off with short stumps than with long ones, and the framework of the resulting trees may be formed closer to the ground.

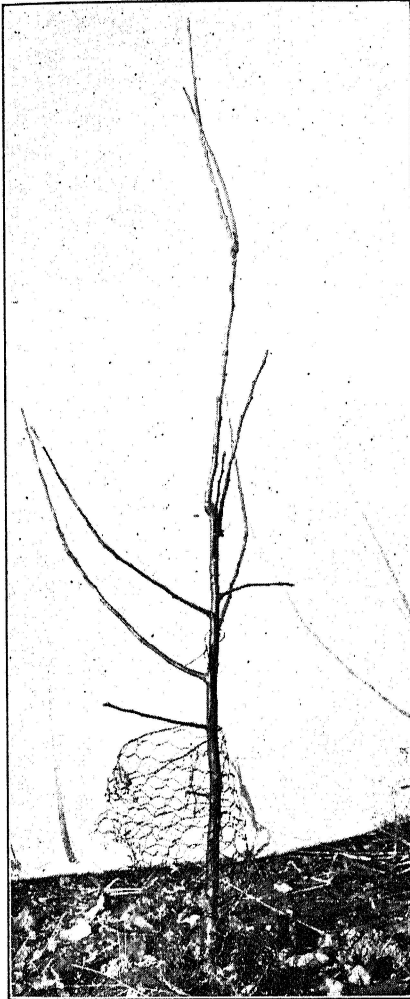


Fig. 1.—An uncut-back Duchess apple tree planted as a one-year-old whip. When photographed, the tree had grown two full years in the experimental orchard.

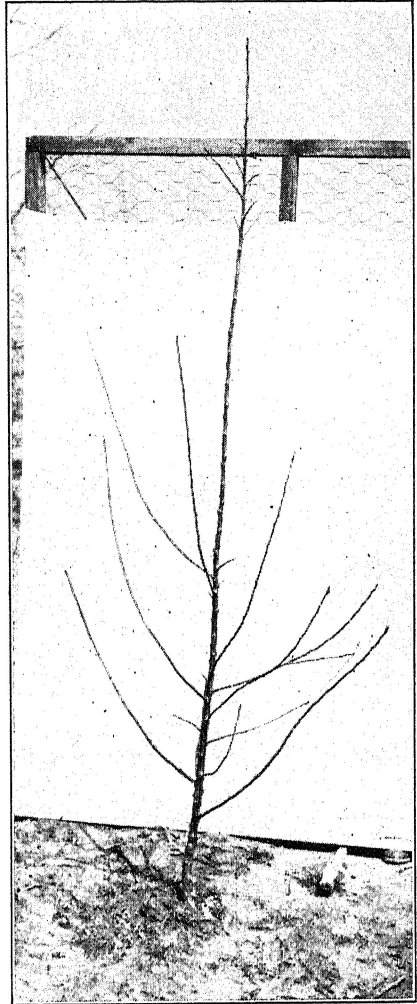


Fig. 2.—A cut-back Golden Delicious apple tree purchased and planted in the same lot as tree in Fig. 1. It was cut-back, however, early in the spring after making one full year's growth in the orchard. Consequently the top is the result of one year's growth from a short stump near the ground.

It seems best to leave a stub 4 or 5 inches long even if a sprout nearer the ground is left and it is necessary to recut the stump on an angle just above the sprout. Trees cut too near the union of stock and scion have a greater tendency to produce suckers from below the graft union. Aside from the fact that the grower may have dif-

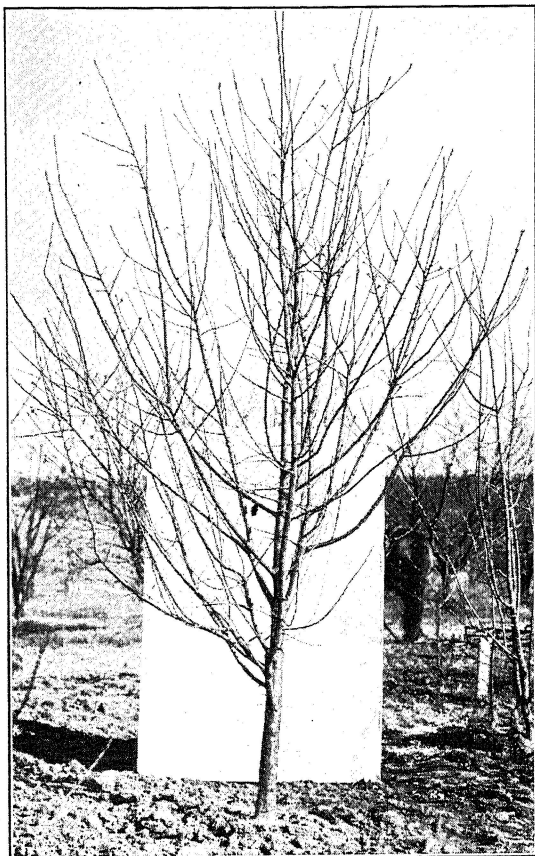


Fig. 3.—A typical uncut-back four-year-old apple tree.

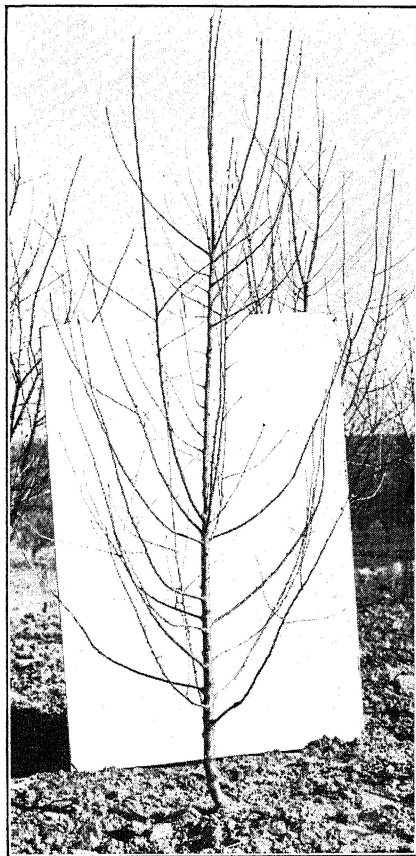


Fig. 4.—A typical cut-back apple tree after two years' growth from a stump about 4 inches high. The tree was planted as a one-year-old, and after two seasons' growth in the orchard it was cut back.

difficulty in recognizing the worthless suckers, these may interfere materially, unless promptly removed, in getting satisfactory sprouts to arise from the stump above the graft union.

TIME TO CUT BACK

To determine the best time for cutting back young apple trees, test cuttings were made in 1924, 1926, 1928, 1930 and 1939. Starting during the last week of March, lots of trees of the standard varieties, ranging from 6 to 10 each, were cut back at intervals of about two weeks up until June 1, inclusive.

During years when good growing conditions prevailed, including plenty of rain, the cut-back trees generally made satisfactory growth up until about May 1. Trees treated after this date did not usually sprout up from the stump as readily as did the earlier cut-back trees. In fact, if unfavorable weather conditions for growth occurred before and after the operation, only about 10 to 20 per cent of the stumps produced sprouts.

Results from many lots of trees ranging in numbers from a half dozen to 50 or more indicate that the best season for cutting back is early in the spring just as growth is starting. The mortality increased as the season advanced, with trials extending until the first of June. The later the cutting back in the spring, therefore, the less likely the tree is to produce satisfactory sprouts to continue its growth and development. Young trees already established, after one or two years' growth in their permanent location respond more readily to cutting back with a considerably higher percentage of successful sprouts arising from the stumps than trees cut back at the time of planting or shortly after. This was particularly noticeable in the trees that were cut back after being injured by rabbits.

CUTTING BACK WEAK TREES

In most plantings, it has been found that anywhere from 5 to 10 per cent or more of the young trees may be classed as unsatisfactory in growth for the first year or two. A study, therefore, was made regarding the advisability of cutting back trees that for some reason fail to make a good growth.

The results show that in practically every instance the so-called weak or stunted trees when cut back were invigorated greatly. When compared to similar untreated trees, the "cut-backs" were observed to be superior in growth and development. After 4 years' growth, cut-back trees generally produced about as large tops as trees which were not treated.

An attack of borers may slow up the growth of trees. This may be particularly true the season following transplanting because a comparatively weak growth may occur, especially in dry years. The results of this investigation indicate that when two-thirds or more of the base of the trunk just beneath the soil on one and two-year-old orchard trees is girdled, cutting back about 4 inches above the ground may be helpful. The work should be done early in the spring, and the sprout for the perpetuation of the variety should arise above the graft union.

Where a portion of the stem or stump is left above the union between the sprout and stump, it is usually well to recut the stump

to facilitate healing at the juncture. The cut should be made in the crotch between the sprout and stump and on a downward slope or angle.

INFLUENCE OF TREATMENT ON AGE OF BEARING

For two or three years following the operation, it was very apparent that the cut-back trees made more growth than the untreated trees. When the different lots of trees began to reach bearing age, 10 to 12 years, the cut-back trees were found to be on the average as early in coming into profitable fruiting as the non-cut-backs. With trees 3 to 4 years old, when cut back it was found that they were delayed in some cases as much as 2 years in coming into bearing when compared to untreated trees. When the trees were cut back after the first or second year's growth in the orchard, however, little or no difference was observed in time of coming into bearing.*

Cutting back at planting time appeared to affect one-year-old trees less than those 2 years old. A larger percentage of the one-year-old trees produced satisfactory sprouts from the stubs or stumps. The shock was not so great for the younger trees and they seemed to overcome it in less time. In growth and development by the end of the fourth year after treatment, the cutting-back effect seemed to have disappeared in most of the trees.

EFFECT OF CUTTING BACK ON OTHER FRUIT TREES AND ON SHADE TREES

During the course of the investigations, comparatively small numbers of other fruit trees including young pear, peach and plum, were subjected to the cutting back treatment. The study also included such shade trees as Carolina poplar, tulip, native river birch, and several different kinds of our native oaks.

The effect on pear trees particularly was like that on apple trees and the response of the other fruit trees to the treatment was not materially different from that of the apple. Moreover, the observations regarding the effect on the branching habit, vigor and time of coming into bearing was, in general, quite similar to the results produced in the case of young apple trees. The treatment was found to be especially applicable in the early years of growth to weakened, stunted, and trunk injured fruit trees.

In general, the effect of cutting back stunted and trunk injured shade trees was beneficial. Stockier and more vigorous trees were usually produced. The effect upon the branching habit was similar to that described for the apple. Moreover, the cut-back trees suffered

*Both treated and untreated trees were given light annual top prunings.

much less from borer attack than untreated trees. The treated shade trees developed rapidly and in 4 or 5 years were about as large in trunk and top growth as the uncut-back ones.

SUMMARY OF INVESTIGATION IN CUTTING BACK

1. Young apple trees up to three years of age inclusive with trunks damaged seriously by hail, rabbits, or from other causes, may be cut back to stumps from 4 to 6 inches high, with the expectation that sprouts will arise from the remaining portion of the stem and continue growth in a satisfactory way. One good sprout arising from above the graft union should be allowed to grow to take the place of the top or part removed.

2. The best season for cutting back is early in the spring just as growth is starting. The mortality has increased as the season advanced up to the first of June. Moreover, the later the cutting back in the spring, the less likely the tree is to produce satisfactory sprouts to continue the growth of the tree.

3. In comparison to normal or untreated trees, no material difference has been noted in the age of coming into bearing, 10 to 12 years, between untreated trees, trees cut back at planting time, and after one to two years' growth in the orchard. Trees cut back after 3 or 4 years' growth in the orchard may be delayed in coming into bearing as much as two or more years.

4. The main or scaffold branches in the cut-back trees were observed to start much nearer the ground. In most instances well placed branches pushed out at heights from 14 to 18 inches above ground and spread out at a much wider angle than branches from trees not cut back. In the treated trees, the branches were better placed up and down the main stem of the tree trunk, enabling the pruner to select without difficulty the branches desired for a well-shaped and well-balanced head.

5. The results of the investigation do not appear to justify the cutting back of all young apple trees to short stumps at planting time or during the first three years of growth in the orchard. It does furnish sufficient evidence, however, to suggest the cutting back of young trees where trunk injuries are serious and where for some reason they fail to make a satisfactory growth during the first or second year after planting.

6. The response from the cutting back treatment on other kinds of young fruit trees was, in general, quite similar to the effect produced on young apple trees. The common shade trees also showed the same effect in vigor of growth and character of branching as that described for young apple trees.

Part II. A Comparison of Pruned and Unpruned Apple Trees

In 1923 an investigation was undertaken to determine some of the effects upon young apple trees when given the following treatments; namely, no pruning, light pruning and heavy pruning.

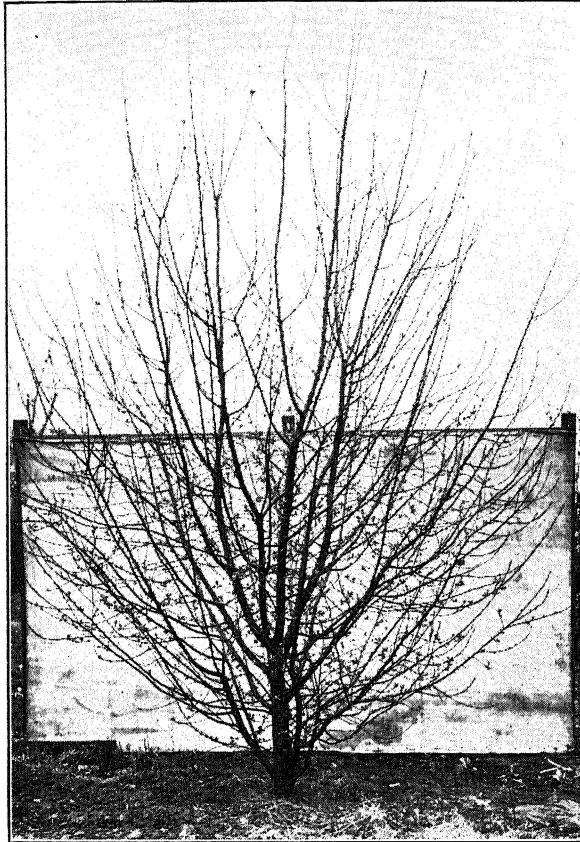


Fig. 5.—A five-year-old unpruned apple tree.

One lot of trees was unpruned but otherwise has been given the same treatment as the other trees. Another lot of trees was pruned at planting time to the modified leader system. A third lot of trees was pruned to the open center system. The two types of pruning and training, and no pruning treatment, were continued each year to 1939, inclusive.

As is well known, the open center system of pruning required rather heavy cutting. The modified leader type required consid-

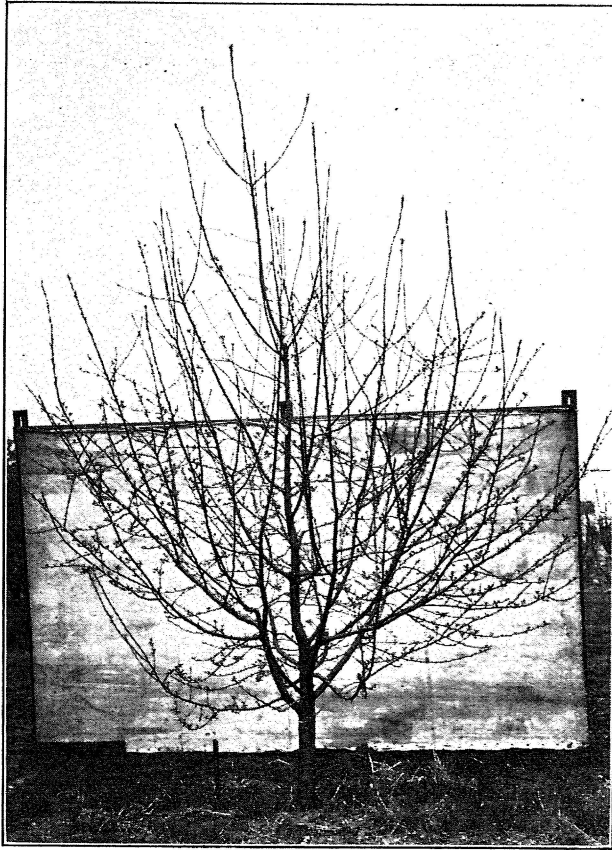


Fig. 6.—A five-year-old apple tree pruned and trained to the modified leader system.

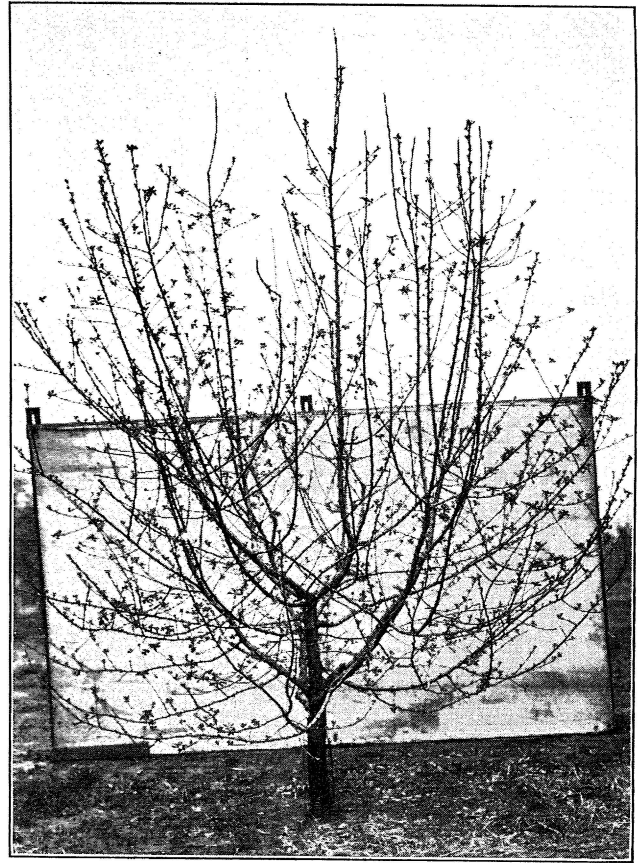


Fig. 7.—A five-year-old apple tree pruned and trained to the open center system.



Fig. 8.—A 16-year-old unpruned apple tree.

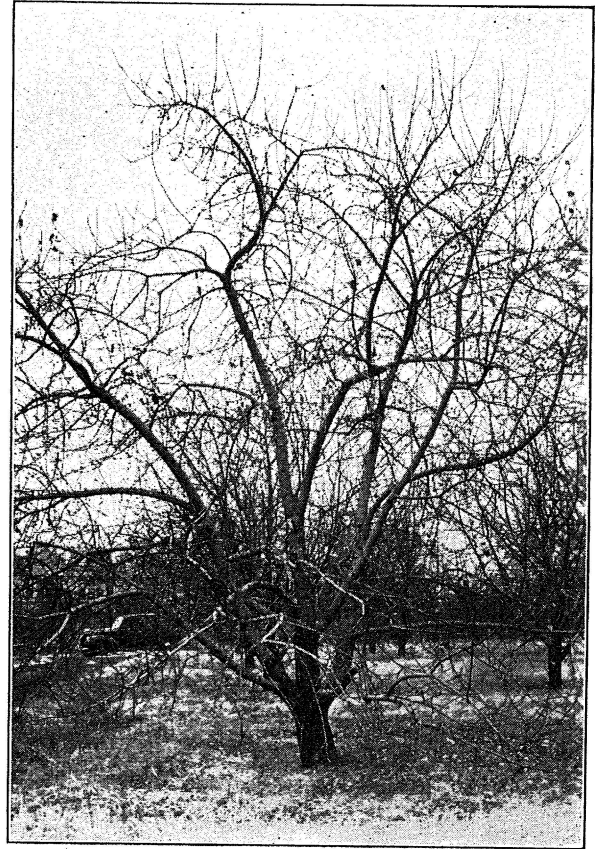


Fig. 9.—A 16-year-old apple tree pruned and trained to the modified leader type.

erably less pruning, while in the third lot of trees pruning has been withheld from planting until the present time.

There is not much difference in height, spread of branches, and trunk circumference between the trees receiving no pruning and those pruned to the modified leader system. A definite reduction in growth, however, has occurred in the trees pruned to the open center type, which was most severe in cutting. This was rather marked in all of the measurements made as is shown in Table 2.

A study of the data presented shows that the heaviest type of pruning, (open center) had the greatest dwarfing effect on growth as measured by height and spread of tops and circumference of trunks. Pruning less heavily (the modified leader system) produced a marked increase in growth as measured by the same standards. Unpruned trees made substantially stronger growth for the first ten years than the trees pruned to the open center or modified leader system.

Close examination of the unpruned trees shows that there is much shading out and dying of both small and fairly large branches due to lack of sunlight. It is also significant to note that five of the unpruned trees have many dead and weak branches and are either dead or in a dying condition, while only two trees may be classed as in bad condition in the pruned blocks. Annual growth of the unpruned trees, color of foliage, and dead and dying wood seem to indicate that a rapid decline in vigor and production is in progress. This condition, it is believed, will gradually grow worse as the trees become older. These unfavorable factors are much less marked in the pruned trees.

Since coming into bearing (10-12 years) good size and color of fruit on the modified leader trees have more than offset the slightly larger average yield of the unpruned trees up to 1937. Since 1937 the modified leader trees have outyielded the unpruned trees as the harvest records indicate for 1939. Moreover, it seems apparent that the modified leader trees will now continue to lead in yields. The open center trees are also catching up in yields with the unpruned trees.

Varietal differences were found to be insignificant when compared to the differences caused by pruning treatments. In this study, therefore, variety influence has been ignored as each tree has been treated as an individual of the species. The growth, fruitfulness and effects of the different types of pruning has furnished ample evidence to warrant such an assumption.

TABLE 1.—GROWTH MADE BY PRUNED AND UNPRUNED TREES FROM TIME OF PLANTING 1923 TO 1939.

Variety	No Pruning					Modified Leader					Open Center				
	Height		Spread		Trunk Circ.	Height		Spread		Trunk Circ.	Height		Spread		Trunk Circ.
	Ft.	Ins.	Ft.	Ins.	Ins.	Ft.	Ins.	Ft.	Ins.	Ins.	Ft.	Ins.	Ft.	Ins.	Ins.
Jeffrey Red	14	11	13	6	18	..	..	..	..	..	..	..	..	..	..
Jeffrey Red	16	10	13	8	18.5	..	..	..	..	..	..	..	..	..	..
Duchess	15	3	13	11	16	13	..	11	7	11	..	..	..	..	..
Rome	17	7	19	..	19.5	14	3	18	..	15	15	5	16	..	16.5
Senator	..	..	..	..	..	17	10	18	..	21.5	..	..	..	..	..
Hyslop Crab	..	..	..	..	..	16	2	19	..	17.5	..	..	..	..	..
Maiden Blush	17	5	21	9	24	..	..	..	..	..	10	7	12	5	14
Golden Delicious	17	5	18	..	22	..	..	..	..	..	..	..	..	..	..
Golden Delicious	18	..	18	..	21	..	..	..	..	..	..	..	..	..	..
Mother	18	10	20	..	24	..	..	..	..	..	..	..	..	..	..
N. Y. Greening	..	..	..	..	..	15	2	15	5	14.5	..	..	..	..	..
Liveland Raspberry	..	..	..	..	..	16	2	13	3	15	13	2	13	2	15
Grimes	17	7	22	..	19	..	..	..	..	..	14	4	13	3	18
Wealthy	16	..	20	9	23	..	..	..	..	..	..	..	..	..	..
Golden Winesap	..	2	..	..	..	16	9	24	..	21	16	9	20	6	21
Wealthy	16	2	14	8	16	..	..	..	..	..	..	..	..	..	..
Fameuse	..	..	..	..	..	16	1	17	2	18	16	2	17	8	20
York	17	4	18	4	21	16	8	18	11	19	..	..	..	..	..
King David	18	6	23	3	22	16	8	18	11	19	9	6	9	10	12.5
Jonathan	..	..	..	..	..	14	3	15	2	15	13	8	14	1	15
Florence Crab	..	..	..	..	..	13	8	9	2	13	..	..	..	..	..
Northern Spy	15	2	11	8	14	13	8	9	2	13	13	8	12	4	20
Sweet Bough	17	11	15	7	21	..	..	..	..	..	..	..	..	..	..
McIntosh	12	2	19	10	20	..	..	..	..	..	12	2	19	10	19.5
Winesap	..	..	..	..	..	13	10	19	..	19	..	..	..	..	..
Minkler	15	5	22	2	24.5	..	..	..	..	..	..	..	..	..	..
Red Astrachan	19	5	18	..	26	..	..	..	..	..	..	..	..	..	..
Collins Red	..	..	..	2	24	18	2	16	6	21	12	2	10	11	12.5
Black Ben	18	8	19	2	22	..	..	..	..	..	13	8	12	6	19
Ben Davis	18	8	20	2	22	14	4	15	3	18	..	..	..	..	..
Ben Davis	18	2	20	8	24	..	..	..	..	..	..	..	..	..	..
Yellow Newtown	..	..	..	..	..	14	8	12	5	19	..	..	..	..	..
Spitzenberg	..	..	..	..	..	13	10	17	8	18	13	9	13	9	17
Total	348	113	376	97	439	238	82	256	54	275	169	72	180	75	220
	or		or		439	or		or		275	or		or		220
	357.4 ft.		384.0 ft.		ins.	244.8 ft.		260.5 ft.		ins.	175 ft.		186.2 ft.		ins.
Average	17.02 ft.		18.29 ft.		20.90 ins.	15.30 ft.		16.31 ft.		17.19 ins.	13.46 ft.		14.32 ft.		16.92 ins.

Correction: Growth reported in this table was made from 1923 to 1931, instead of 1923 to 1939 as erroneously printed in the heading at top of page.

TABLE 2.—GROWTH MADE BY PRUNED AND UNPRUNED APPLE TREES FROM TIME OF PLANTING 1923 TO 1939.

Variety	No Pruning					Modified Leader					Open Center				
	Height		Spread		Trunk Circ.	Height		Spread		Trunk Circ.	Height		Spread		Trunk Circ.
	Ft.	Ins.	Ft.	Ins.	Ins.	Ft.	Ins.	Ft.	Ins.	Ins.	Ft.	Ins.	Ft.	Ins.	Ins.
Duchess	..	..	..	..	..	16	6	17	6	27.5	..	..	14	..	..
Duchess	..	..	..	..	..	..	..	..	..	..	10	6	14	..	17.5
Rome	17	6	21	6	29	..	..	..	..	..	..	..	..	..	..
Rome	18	..	23	..	35	..	..	..	..	..	..	..	..	..	..
Senator	..	..	..	..	..	18	..	27	6	41	..	..	..	..	..
Hyslop Crab	..	..	..	..	..	17	..	25	..	29	..	..	..	..	..
Maiden Blush	..	..	..	..	..	19	..	24	6	38	..	..	..	..	..
Maiden Blush	..	..	..	..	..	..	..	..	..	..	17	..	14	6	23.5
Golden Delicious	20	6	21	..	30.5	..	..	..	..	..	..	..	..	..	..
Golden Delicious	..	..	..	..	..	17	..	20	6	30.5	..	..	..	..	..
N. W. Greening	..	..	..	..	..	18	..	24	..	34	..	..	..	..	..
Liveland Raspberry	..	..	..	..	..	16	..	18	6	29.5	..	..	..	..	..
Liveland Raspberry	..	..	..	..	..	..	..	..	..	..	16	6	16	6	26
Wealthy	18	6	20	..	27.5	..	..	..	..	..	..	..	..	..	..
Golden Winesap	..	..	..	..	..	16	6	23	6	35.5	..	..	..	..	..
Golden Winesap	..	..	..	..	..	..	..	..	..	..	17	..	24	..	34
Fameuse	18	..	27	..	36	..	..	..	..	..	..	..	..	..	..
Fameuse	17	6	17	..	19.5	..	..	..	..	..	..	..	..	..	..
York	19	..	23	..	33	..	..	..	..	..	..	..	..	..	..
King David	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
King David	20	..	30	..	38	..	..	..	..	..	18	6	23	6	23.5
Florence Crab	..	..	..	..	..	15	..	19	6	25.5	..	..	..	..	..
Florence Crab	..	..	..	..	..	..	..	..	..	..	15	..	17	..	25
Northern Spy	18	6	17	6	29.5	..	..	..	..	..	..	..	..	..	..
Northern Spy	..	..	..	..	..	16	6	18	6	30	..	..	..	..	..
Sweet Bough	18	..	23	..	35.5	..	..	..	..	..	..	..	..	..	..
Sweet Bough	..	..	..	..	..	..	..	..	..	..	18	..	23	6	37
McIntosh	..	..	..	..	..	..	..	..	..	..	18	6	22	..	28
Winesap	18	6	23	..	29	..	..	..	..	..	..	..	..	..	..
Winesap	..	..	..	..	..	..	..	..	..	..	16	..	19	6	32.5
Collins Red	..	..	..	..	..	..	..	..	..	..	17	6	16	6	24
Collins Red	..	..	..	..	..	21	6	22	..	38.5	..	..	..	..	..
Black Ben	20	..	20	..	38	..	..	..	..	..	..	..	..	..	..
Black Ben	20	..	25	..	36.5	..	..	..	..	..	..	..	..	..	..
Ben Davis	19	6	23	..	35	..	..	..	..	..	..	..	..	..	..
Yellow Newtown	..	..	..	..	..	..	..	..	..	..	17	..	20	6	33.5
Total	260	42	313	12	452	189	24	237	48	359	179	30	208	42	304.5
Average	18.82 ft.		22.42 ft.		32.2 ins.	17.36 ft.		21.9 ft.		32.6 ins.	16.5 ft.		19.2 ft.		27.68 ins.

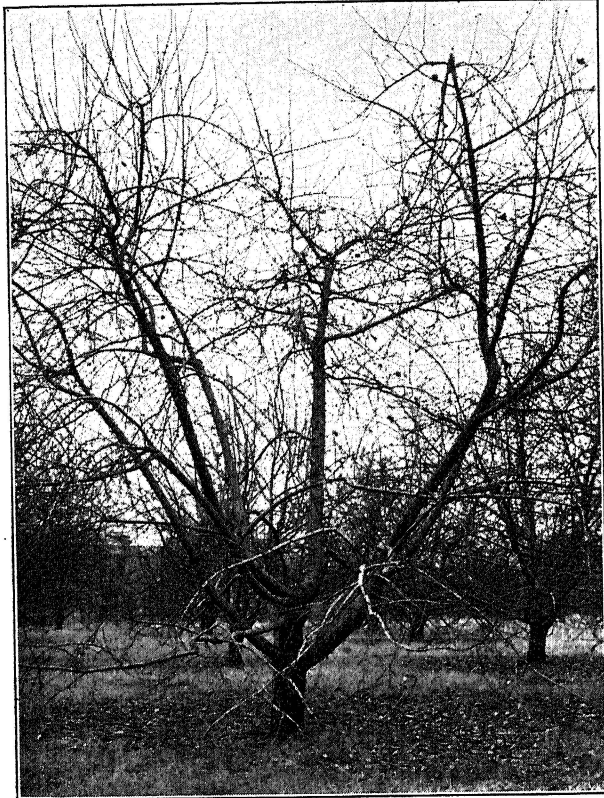


Fig. 10.—A 16-year-old apple tree pruned and trained to the open center type.

TABLE 3.—YIELD PER TREE FROM UNPRUNED AND PRUNED APPLE TREES.
AGE OF TREES—14 YEARS.

Date—1937	No Pruning	Modified Leader	Open Center
Variety	Yield Bu.	Yield Bu.	Yield Bu.
Duchess .....	...	3.0	2.0
Rome	5.0	...	...
Rome	3.0	12.0	...
Senator .....	...	...	...
Golden Delicious	6.0	8.0	...
N. W. Greening .....	...	6.0	...
Liveland Raspberry .....	...	4.0	2.0
Golden Winesap .....	...	6.0	4.0
Fameuse	11.0	...	...
King David .....	...	8.0	6.0
Florence Crab .....	...	6.0	3.0
Winesap	10.0	...	...
Collins Red .....	...	5.0	3.0
Black Ben	10.0	...	...
Black Ben	10.0	...	...
Ben Davis	6.0	...	...
Yellow Newtown .....	...	...	3.0
Average	7.62 bu.	6.44 bu.	3.28 bu.

TABLE 4.—YIELD PER TREE FROM UNPRUNED AND PRUNED APPLE TREES.
AGE OF TREES—16 YEARS.

Date—1939	No Pruning	Modified Leader	Open Center
Variety	Yield Bu.	Yield Bu.	Yield Bu.
Duchess .....	...	7.0	1.5
Rome	12.0	...	...
Rome	9.8	...	...
Senator .....	...	20.0	...
Maiden Blush .....	...	8.75	2.25
Golden Delicious	10.0	13.0	...
N. W. Greening .....	...	11.5	...
Liveland Raspberry .....	...	11.5	2.25
Wealthy	8.0	...	...
Golden Winesap .....	...	11.75	8.5
Fameuse	1.5	11.0	...
York	1.0	...	...
King David .....	...	19.0	17.75
Northern Spy .....	...	8.5	...
Sweet Bough .....	.75	...	3.12
McIntosh .....	...	...	4.0
Winesap	1.25	...	7.0
Collins Red .....	...	16.5	4.25
Black Ben	7.0	...	...
Black Ben	25.66	...	...
Ben Davis	5.66	...	...
Yellow Newtown .....	...	...	13.66
Average	7.51 bu.	12.5 bu.	6.43 bu.

SUMMARY ON COMPARISON OF PRUNED AND UNPRUNED APPLE TREES

1. The pruning of young apple trees, whether light or heavy, has a tendency to reduce the leaf area and to that extent to be a dwarfing process. Unpruned and lightly pruned trees have markedly greater height, spread, and trunk circumferences than heavily pruned trees.

2. Pruning delays the time of coming into bearing. The heavier or more severe the cutting, the greater the delay when compared to unpruned trees.

3. The modified leader type of pruning dwarfs young trees slightly in growth and delays bearing somewhat in the early years, yet it produces a comparatively low, spreading tree with a large number of well placed lateral fruiting branches. Moreover, at the profitable bearing period, 10 to 12 years, the modified leader trees produce as much or more fruit than unpruned trees and the fruit ranks considerably higher in quality.

4. The open head type of pruning requires severe cutting. Consequently, profitable bearing may be delayed as much as two years. Since the bearing surface of the trees is greatly reduced, the yield may be reduced nearly one-half in the early years of fruiting. The mechanical framework of this type of tree is weaker than the other forms. The open center tree does have the advantage, however, of being low and spreading which facilitates such orchard operations as spraying, harvesting and pruning.

5. Unpruned trees cannot be justified except upon the grounds of a lack of knowledge on pruning. While it is true unpruned trees come into bearing earlier and they are slightly larger than pruned ones, yet they are likely to become so thickly branched at profitable bearing time as to cause a large percentage of the fruit to be poorly colored and show scratches and punctures from limb rub and spur contact. Moreover, the longer the tree goes without proper pruning, the more worthless it becomes for producing good fruit.

6. The length of tree life tends to be shorter in unpruned trees. This may be due, partly at least, to the shading out and dying of branches. Earlier and heavier bearing may also tend to shorten the existence of the trees.

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