Pruning Apple Trees in Illinois

BY R. S. MARSH

University of Illinois
College of Agriculture and Agricultural Experiment Station
Circular 349

CONTENTS

Urbana, Illinois October, 1929

Printed in furtherance of the Agricultural Extension Act approved by Congress May 8, 1914.
H. W. MUMFORD, *Director,* Agricultural Extension Service, University of Illinois.

Pruning Apple Trees in Illinois

By R. S. MARSH, Associate Professor, Horticulture Extension

For twenty-five hundred years pruning has been based on opinions, ideas, and superstitions. Within the last twenty-five years, however, scientific methods for determining facts have been applied to the problem of pruning. New principles have been developed, so that a large amount of guesswork can now be eliminated. The recommendations in this circular are based on these new principles. While still better methods may be developed by investigations now in progress, the methods described herein represent a distinct advance over many of the practices followed in this state at the present time.

Kind of Trees to Plant

Growers are advised to purchase one-year-old whips 4 to 5 feet tall with a caliper of 7/16 inches or more. Good, healthy, one-year-old nursery stock is less expensive than two- or three-year-old stock, and there is little question of its vigor. Very little can be gained in earliness of production by using the older trees.

Either budded or grafted nursery stock can be used. The main thing for growers to look for is good, clean, healthy nursery trees sold by reliable nurserymen who fill the order with the varieties selected.

Planting Distances

Forty feet is the minimum planting distance recommended for apple trees. With present methods of soil management and pruning, the large tops developed on apple trees need much space. Double planting and interplanting with other trees may not prove profitable in this state because growers often wait too long before removing temporary trees.

The problems of pruning and otherwise treating old trees are greatly simplified if the trees are spaced at least 40 feet apart. The evils of close planting are shown in Fig. 2.

Heading Newly Set Apple Trees

New and promising methods for forming the heads of apple trees are being developed at this Station by Dr. W. A. Ruth and Dr. V. W. Kelley; the results of their investigations have been given rather wide application thru the extension work of the University and are freely

drawn upon in this circular.[1] The ideal tree is one on which there are four or five wide-angled scaffold branches spaced 6 to 12 inches apart along a central leader. The scaffolds should be arranged to balance the tree in all directions. Occasionally two branches may be left ap-

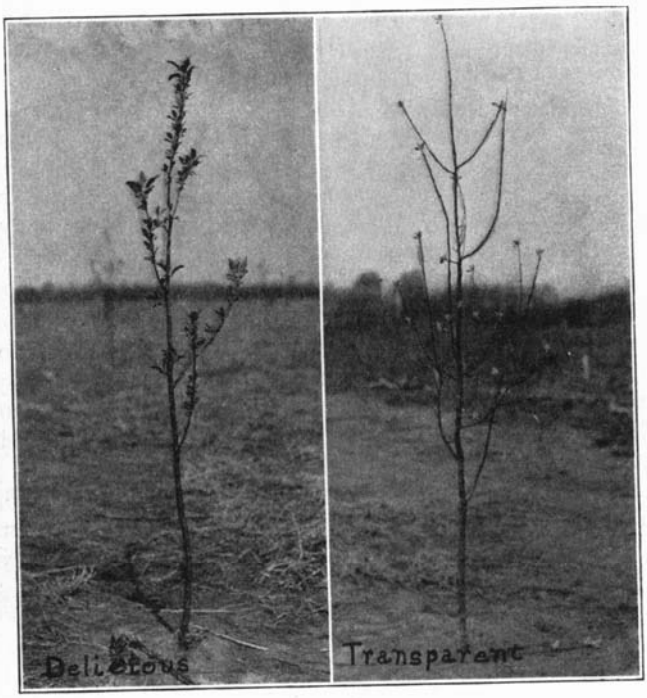

FIG. 1.—CORRECTLY TRAINED YOUNG TREES

At the left is shown a pruned Delicious apple tree one year after planting and at the right is a pruned Transparent after one year in the orchard. Observe the wide-angled scaffold limbs spaced 8 to 10 inches apart.

proximately the same height if on opposite sides of the tree. In the usual method the first heading cut that is made on a one-year-old apple whip determines the height of the head, or the distance from the soil surface to the first primary scaffold limb. The recommended height is 26 to 30 inches, so the whip is cut back to about the latter height, altho strongly growing trees in good condition can be headed somewhat higher.

[1]The author acknowledges the constructive assistance rendered by Drs. Ruth and Kelley in the preparation of this circular. Much of the data and most of the photographs were taken from their collection.

Selecting Buds for Scaffold Limbs

The first wide-angled scaffold limb will be developed from the third or fourth bud below the heading cut.

The first bud that grows below the heading cut produces a shoot which takes the position of a central leader in the tree. The second bud growing out below the cut will usually produce a shoot having a narrow angle with the trunk. Since narrow angles give weak

FIG. 2.—THE EVILS OF TOO CLOSE PLANTING

The lower limbs of these trees have been shaded out of production because of the close distances between them. A 40- to 50-foot planting distance gives sufficient area in the middle of the rows to carry on a soil-building program in young orchards and gives lower fruiting wood when trees are older.

crotches that readily split when the mature tree is loaded with fruit, it is necessary to remove these narrow-angled shoots. This should be done the following winter, when all shoots having angles of less than about 45° with the central leader should be removed. The angle can be somewhat less in spreading varieties and greater in upright varieties. Fig. 3 illustrates weak and strong crotches on trees.

In the case of exceptionally vigorous trees the third bud from behind the heading cut may also produce a shoot that has a narrow angle with the leader, but usually the third and fourth buds back of the cut will produce shoots with *wide* angles and such shoots can be used for permanent scaffolds. If the cut was relatively severe, it may be necessary to go down farther for a wide-angled branch.

Only one scaffold, or in case the cut was made high on the whip, two should be left up and down the trunk. It is well to have the first selected scaffold pointing in the direction of the prevailing wind.

Encouraging Lateral Branching by Summer Tipping

When the shoot that has the position of the central leader has grown to a length of 8 or 10 inches, it should be pinched back so as to encourage further lateral branching. At this time a leaf can be selected which is 8 or 10 inches above the highest permanent scaffold and that points in a direction where a scaffold is needed to balance the framework of the tree. Having selected this leaf, the shoot is pinched back to

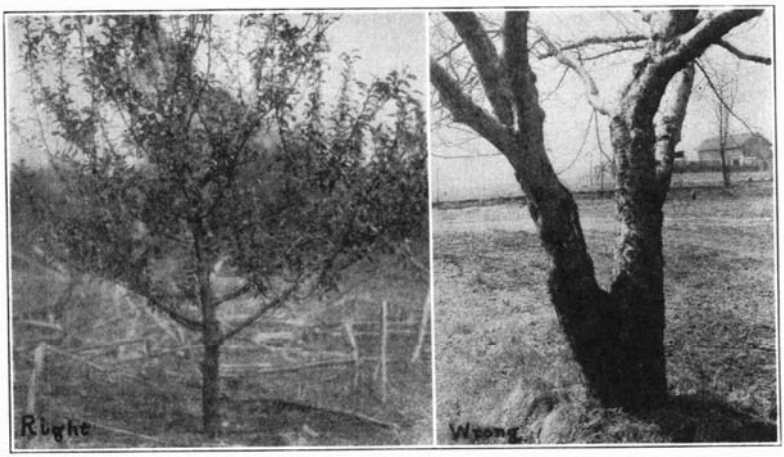

FIG. 3.—STRONG, WIDE-ANGLE CROTCHES BEST

The tree at the left is correctly scaffolded and is ready for light pruning treatment. The picture was taken in May during the tree's third growing season after planting. A narrow crotch such as the one on the right is weak, causing the tree to split and to be of short life in the orchard.

the leaf above. Care should be taken not to pinch too close to the uppermost leaf lest the bud in its axis be injured. The bud on the shoot at the base of the top leaf will produce a shoot which will continue vertically in the direction of the central leader. The bud at the base of the second leaf (the leaf selected) will normally produce a slow-growing shoot which has a wide angle and can be used as a permanent scaffold. Sometimes, however, the second bud will develop a shoot with too narrow an angle; in this case the third or fourth bud will probably develop a usable shoot. If no suitable shoot develops during the remainder of the summer, development will probably take place in the season following.

Training Tree Second Season in Orchard

By heading the leader again in the winter and considering the third or fourth bud back of the proposed cut as the one which is most likely to give a permanent scaffold, a wide-angled lateral shoot can be preserved for another permanent scaffold branch. During the growing season of the second year, summer tipping can be practiced if another scaffold needs to be developed for balancing the tree. During the first two years of training, permanent scaffolds should not be cut back unless they tend to outgrow the central leader.

Thus four or five well-spaced, wide-angled scaffold limbs are developed during the first two years in the orchard.

If a two-year-old tree is received from the nursery, the branches with narrow angles should be removed. One or two wide-angled scaffolds should be left and the leader cut back according to the method given for pruning the tree during the second season.

Pruning to Preserve Framework on Young Trees

During the third and fourth years the permanent scaffolds should be kept dominant, and the central leader should be dominant to all other branches on the tree. This is done by cutting out strongly competing limbs or cutting them back so they are dwarfed. Small twigs and branches should be left because the leaves they bear help to nourish the tree. During this training period it is best to make only essential cuts, as light pruning preserves the leaf area, giving greater growth and earlier production.

There seems to be no reason for cutting out the central leader after the desired scaffold system is obtained, since normally the scaffolds will grow to about an equal height with the central leader and give a well-rounded tree. If, however, the tree becomes too pointed and cone shaped, the leader may be cut back to a lateral.

It is necessary to keep the young trees in a vigorous growing condition if this method of training is used. This is done by cultivation and by protecting the tree against insects, diseases, and rodents. Trees that make only a small amount of growth during the season should be fertilized either with barnyard manure or some commercial nitrogenous fertilizer, such as calcium nitrate, ammonium sulfate, or nitrate of soda. Usually only one-fourth pound of these commercial fertilizers is used for every year that the tree has been growing in the orchard. The material should be broadcast on the soil underneath the branches of the tree during the latter part of April or the first of May. Barnyard manures are best applied in the late fall on the soil around the tree in such a way that the material does not touch the trunk.

Disbudding Young Nursery Whips

This Station has tested in its orchards a popular suggestion regarding a method of disbudding young trees designed to develop four or five well-spaced scaffold limbs in one growing season. The following procedure is recommended.

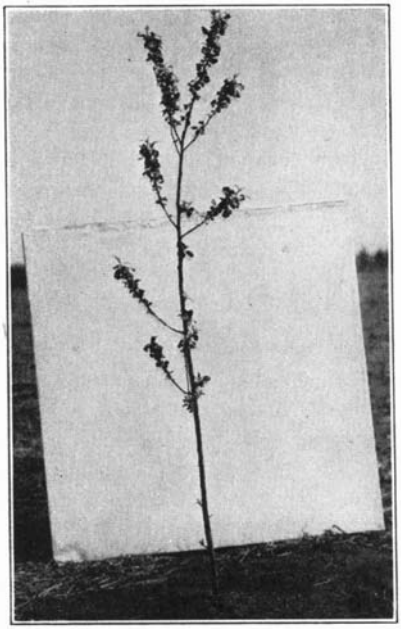

FIG. 4.—ONE SEASON'S GROWTH RESULTING FROM DISBUDDING

This Jonathan whip was disbudded to four groups of four buds each and all other buds removed at the time of planting. No heading back was done. The 6- to 12-inch spacing between bud groups gives a thin, open-head condition, allowing for stocky growth and strong secondary scaffold development.

Beginning about 28 or 30 inches above the ground, a group of four buds is selected. The first six or eight buds on both sides of this chosen group are removed. Then a second group of four buds is chosen above the first group selected, and so on up the tree, saving groups of four buds at intervals of 6 to 8 inches and removing all other buds. Four or five bud groups are saved and from these groups lateral shoots will develop. After one season's growth, selection should be made of those shoots having a wide angle with the central leader (see Figs. 4 and 5).

A 4½- or 5-foot, year-old whip is necessary if this method is to be adopted. No heading back is done.

Variety Response to Heading Treatment

Grimes and *Rome* are varieties most easily trained. Usually a heading cut on the Grimes and Rome whips will stimulate growth in lateral buds 18 to 20 inches back of the cut and most of the lateral shoots will have strong, wide angles with the central leader. These two varieties, therefore, can be headed 36 to 40 inches high when set out.

Delicious, Yellow Transparent, and *Duchess* are varieties that are difficult to train because they form narrow and weak crotches, and a heading cut stimulates only three to five lateral buds into growth.

Jonathan, Willow Twig, and *Winesap* are an intermediate group and respond readily to the heading treatment. Double leaders in Winesap, particularly Staymen, must be avoided by removing one of the leaders. Slow-growing shoots with right-angled crotches cannot be depended upon to make sufficient development for permanent scaffolds, particularly in Winesaps, Jonathans, and Willow Twigs.

Light Pruning for Young Growing Trees

As soon as the tree is trained so that it has four or five strong scaffold limbs, vigorous water sprouts and limbs that are rubbing should be removed. This constitutes a very light pruning, only a small amount of wood being removed annually. A common mistake that growers are making is that of pruning young trees too heavily. Pruning experiments at the Illinois Station and at six other state experiment stations have established the following facts.

1. The more a young tree is pruned, the later it comes into bearing.
2. The more a young tree is pruned, the smaller is its ultimate size.
3. The more a young tree is pruned, the less is the yield.

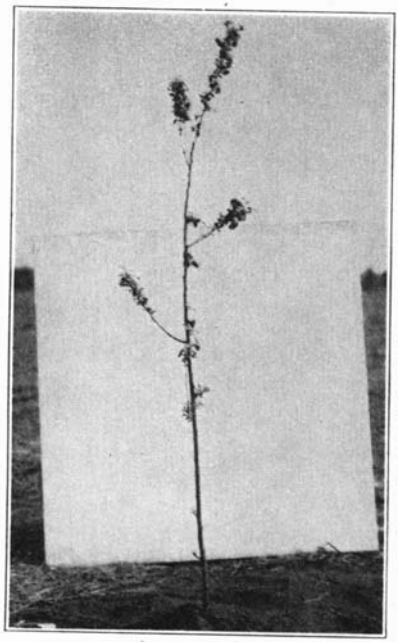

FIG. 5.—SCAFFOLDS SELECTED AFTER DISBUDDING TREATMENT

This shows the same Jonathan tree as in Fig. 4. Strong scaffolds have been selected to balance the tree and the spacing is good. The "leggy" appearance should disappear after two seasons of additional growth.

In other words, pruning is a dwarfing operation which delays bearing and cuts down the yield on young trees. Dr. W. A. Ruth and Dr. V. W. Kelley of this Station have prepared the following table, showing how the growth and production of young apple trees are affected by pruning. The figures in the table were gathered from a pruning block of 800 trees divided between the varieties Duchess and Wealthy.

Where the pruning treatment had been one of moderate thinning, 85 percent of the trees were bearing at the age of seven years (1927).

Where pruning was heavy, only 70 percent of the trees were bearing in 1927. Where no pruning was given, 95 percent of the trees were bearing.

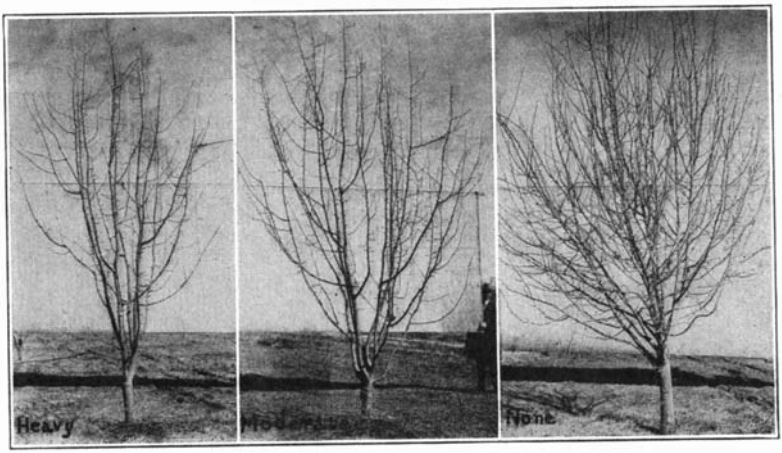

FIG. 6.—EFFECT OF HEAVY, MODERATE, AND NO PRUNING ON DEVELOPMENT OF 7-YEAR-OLD DUCHESS TREES

The heavier the pruning, the more dwarfing that occurs on trees at this age. Yields are lower and fruiting is delayed. In 1927 the unpruned tree was yielding 35 pounds of fruit; the moderately pruned one, 8¾ pounds; and the heavily pruned one, only 5 pounds.

It is interesting to observe the yield on these young bearing trees. The average yield from the unpruned trees in 1925 was 10.8 pounds; in 1926, 12 pounds; and in 1927, 37 pounds. The moderately thinned trees produced an average of only 5.4 pounds in 1925; in 1926 they yielded less than one-half the yield from the unpruned trees, and in 1927 only one-fourth of that yield. Where heavy pruning was given, the average yield per tree in 1925 was less than one-third that

EFFECT OF PRUNING ON GROWTH AND PRODUCTION OF YOUNG TREES SET OUT IN 1920: ILLINOIS EXPERIMENTS

	Growth in trunk diameters			Trees bearing	Average yield per tree		
Pruning treatment	1924	1928	Increase	1927	1925	1926	1927
	inches	*inches*	*perct.*	*perct.*	*lbs.*	*lbs.*	*lbs.*
Moderate thinning.....	8.65	15.00	75	85	½ of check tree	−½ of check tree	¼ of check tree
Heavy thinning.....	8.51	14.22	67	70	−⅓ of check tree	−¼ of check tree	⅓ of check tree
No pruning, or check tree	8.61	15.90	85	95	10.8	12.0	35.0

of the unpruned trees, less than one-fourth in 1926, and only one-seventh in 1927. Thus the trees receiving pruning treatments have lost ground steadily in yield when compared with the unpruned trees.

The unpruned trees, it will also be noticed, increased 85 percent in size during the period 1924 to 1928, while the moderately pruned trees increased only 75 percent and the heavily thinned trees only 67 percent. The relative sizes of these trees in 1926 after two years of pruning are shown in Fig. 6.

In view of the facts gathered from this experiment covering 800 trees, growers should be very careful about every cut that is made during the pruning season.

Shape of Young Tree Changed by First Crops

A young apple tree that has not had a crop has most of its branches growing in an upright position. As the tree bears its first two or three commercial crops, these branches are pulled from their upright position to one more nearly horizontal. A tree coming into production, therefore, radically changes its general appearance, and limbs that interfere when the branches are in an upright position may have plenty of room for growth after a crop has caused the branches to take a horizontal position.

FIG. 7.—FIVE-YEAR-OLD TREE WITH BRUSH REMOVED

Such light pruning permits the tree to make greater growth, earlier production, and heavier yields.

Fruit Size and Color Indicate Pruning Need

Light pruning should be practiced on apple trees after they have been two or three years in the orchard and until they are twelve and in some varieties twenty years from planting. Fig. 7 illustrates the small amount of brush that was taken from a five-year-old tree in order that it could make maximum growth and come into production at an early age. The owner of the orchard is holding in his hand the brush that was pruned out of the tree in the background. Removal of this brush was accomplished by taking out only vigorous

water sprouts and some of the badly rubbing limbs. This light pruning is recommended to continue until the fruit shows indications of becoming small in size or, on red varieties, the color development poor.

FIG. 8.—ABUNDANT BLOOM IN CENTER OF AN UNPRUNED DUCHESS TREE

In this tree shading has not been heavy enough to prevent blossom bud formation and pruning has not been necessary. Note thickness of the brush on this tree by comparing it with the unpruned tree, of the same age, shown at the right in Fig. 6.

An unpruned Duchess tree at the University during the blooming season of 1929 is shown in Fig. 8. The large amount of bloom back in the center portion of this nine-year-old tree is to be noted. The same characteristic has been observed with other varieties that have been pruned very lightly.

The Indiana Experiment Station found a rather heavy set of fruit in 1928 back in the center of unpruned Grimes trees. During

the first six years of production the average yield of the heavily pruned trees was less than 50 percent of the yield from the unpruned or lightly pruned trees. A grower in western Illinois harvested three barrels of apples from an eight-year-old unpruned tree and claimed that at least one-third of the fruit was in the center of the tree.

It would seem preferable for growers to do no pruning at all on young trees rather than to prune them heavily. However, something can be gained by a very light thinning-out treatment given the trees annually.

Detailed Pruning for Mature Trees

Following light pruning, the lower half of a mature apple tree will usually become very dense and brushy, and the fruit produced on this portion of the tree is likely to be of small size and, if it is a red variety, of poor color. This can be corrected by giving the tree a detailed pruning. This consists of cutting out from one-third to one-half of the smaller twigs, so that fewer fruits of large size will be produced. This thinning treatment admits sufficient sunlight to increase the color on the red varieties.

In order that the stimulus from pruning be well distributed over the tree, it is recommended that cuts be limited to small sizes, preferably less than three-quarters of an inch in diameter. Larger cuts are slow to heal and usually cause a troublesome growth of water sprouts. Weak, slow-growing branches and twigs should be removed from the under side of the main scaffolds. The more vigorous growth on top of the branches should be left for fruit production, and water sprouts along the top of scaffold limbs cut back so that they are 18 inches high and thinned out so they are 18 inches apart. In time such sprouts will produce excellent fruit. Figs. 9 and 10 show a 35-year-old Jonathan tree before and after detailed pruning. This tree received 1,860 cuts, requiring 3 hours of one man's time to complete the pruning treatment. On a similar tree 389 cuts were made, and only 1 hour was required to prune the tree. For commercial purposes, cuts on this latter tree were of sufficient detail to produce results. This type of pruning demands the use of picking ladders, as the pruning must be done toward the ends of the branches where the fruit is produced if much gain in size and color is to be obtained. (See Fig. 11)

Some growers like to prune apple trees so that a team of horses can be conveniently driven under the branches and yet all fruit may be picked from the ground. This leaves a rather narrow fruiting zone. It is recommended, however, that branches be left low on bearing trees, as this helps to preserve moisture by shading the soil around the tree. Some of the low-hanging branches may be pruned back if they permit too much fruit to lie on the ground at harvest.

Tops of bearing trees may be lowered by cutting back to lateral branches. This lowering process should be done over a period of three

FIG. 9.—AN OLD JONATHAN TREE BEFORE DETAILED PRUNING

FIG. 10.—THE SAME JONATHAN TREE AFTER DETAILED PRUNING

In order to give larger fruit sizes, increased color, and to stimulate new growth, 1,860 cuts were made, requiring three hours' work. On a commercial basis these cuts can be reduced to 400 or 500 and the time to one hour.

years so as to avoid sun scald. Longer picking ladders and wider planting distances help to solve the problem of higher tree tops.

Each Mature Tree an Individual Problem

The question now arises as to just how much pruning should be given mature trees of the different varieties. The Northwestern Green-

ing where, as a rule, fruit sizes run from medium to large and of course the color is green, would seem to require different treatment from the common Winesap, where fruit sizes are likely to run quite

FIG. 11.—GROWTH RESPONSE TO DETAILED PRUNING
Notice the vigorous upright growth which has followed a rather heavy detailed pruning. Such vertical growths constitute new and vigorous wood which in time will produce large-sized fruits.

small on old trees and color development be very poor. Perhaps this question can be answered best by considering conditions at the time of harvest. The only reason for pruning the Northwestern Greening would seem to be to lessen the amount of limb rub on the fruits and probably to facilitate spraying. Much will be gained in pruning Winesaps sufficiently to encourage larger sizes and good color because of the premiums paid for fancy grades.

Prune Old Trees, Train Young Trees

In conclusion, train the young tree so it will have strong, wide-angled scaffolds spaced from 6 to 12 inches along a central leader.

Prune young trees lightly to obtain early productiveness and greater quantities of fruit. Prune older trees with small cuts so as to reduce the number of growing points, to obtain larger fruit, and to get deeper color on red varieties. This detailed pruning facilitates spraying and in general regenerates old trees that are slow-growing and not productive.

Usually it will be found profitable to concentrate one's pruning efforts on old trees, and give young trees proper training during the first two years after planting, not forgetting that each apple tree as well as each variety requires individual pruning treatment because of growth, soil, variety, health, and age differences.