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SOIL MAINTENANCE AND PRUNING METHODS FOR PEACHES AND APRICOTS

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Soil Maintenance and Pruning Methods for Peaches and Apricots

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Introduction

Soil fertility and methods of pruning are of great importance in the culture of peaches and apricots. This is due to the fact that with these fruits a constant renewal of fruiting wood is required to maintain annual bearing and profitable production. Peaches fruit only on one-year-old wood, and apricots bear on one-year-old wood and spurs which seldom live longer than three years. It is important, therefore, to know which pruning and soil maintenance practices result in optimum renewal of fruiting wood and consequently give greatest returns throughout the life of the tree. With this objective the experiment reported in this bulletin was undertaken.

REVIEW OF LITERATURE

Soil Maintenance

It is generally conceded that with all fruits a soil rich in humus is conducive to far better growth and cropping than a soil low in organic matter. McCue (11) found that under conditions in Delaware the cowpea and soybean are the best cover crops for peaches. With one of these cover crops used every year it was possible to maintain a satisfactory nitrogen supply. According to Chandler (5) one of the most popular cover crops for orchards in New York is red clover. Under the semi-arid conditions of Southern California, Vaile (18) found that a good winter leguminous cover crop was about equal to five tons of manure. However, in a light soil it required about ten tons of manure a year in addition to cover crop to keep the organic matter of the soil equal to that of a virgin soil. Trees in soil so treated gave the highest yields. In California, according to Overholser and Duruz (12), "The planting of some crop in the fall to be turned under early in the spring, while green, is being increasingly practised. This is to be recommended where there is sufficient rainfall or irrigation water available in the fall, since the annual ploughing under of a cover crop improves the tilth and helps maintain the soil nitrogen supply."

Of all fertilizer elements applied to peach trees, nitrogen only has been found to yield consistently beneficial results when applied in the right amounts. Alderman (1), Blake (3), Cooper and Wiggans (6), Overholser and Duruz (12), have all shown that increased growth and production resulted from the application of nitrogenous fertilizers.

Pruning

Numerous experiments have been conducted relative to pruning of peaches. Formerly stress was laid upon the desirability of heavy pruning throughout the life of the tree. More recently lighter pruning of the thinning-out type has come into favour. Schrader and Auchter (14), Gourley (8), Cullinan (7), Blake (2), and Chandler (4) have all shown that a marked reduction in yield with young

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trees up to five years in age results from heavy heading or "short" pruning in contrast with light thinning out or "long" pruning. Cullinan (7) has shown, however, that as the trees grow older differences in yield between trees receiving heavy and light pruning cease to be important. Talbert (15) notes that severity of pruning may well be gauged by waiting until the trees come into flower in the spring. He recommends that if the fruit bloom is heavy, the pruning should be heavy to reduce the crop and stimulate new wood growth for next year. If the bloom is light, the pruning should be light so as to secure as much fruit as possible.

With apricots some diversity of opinion exists as to the most satisfactory type of pruning. Tufts (16, 17) has shown that long pruning with both young and old trees has resulted in enormously increased crops in comparison with short pruning. Despite a slight reduction in size of fruit with long pruning, he is satisfied that this is the method that will yield most profitable returns. To quote (16): "From a study of the fruiting habit of the apricot and of the response that the tree makes to heading back and thinning out, it would seem desirable to prune sufficiently severely each year so that a moderate amount of new growth will be obtained which may be retained for fruiting purposes for three to five years, and then cut away as having served its usefulness, and by its removal encourage new growth." Howard (9) further supports the system of long pruning for apricots, both young and old trees. He states that as long as the trees are making a reasonable growth and the fruit sizes up well, no heading back should be practised. He further emphasizes the advantages of long pruning in renovating old short-pruned trees. Removal of a large number of old scaffold branches encourages fruit spurs to form in the centre of the tree on the bare branches. The height of tree is not increased by long pruning, since the new long shoots bend over with the weight of crop. On the other hand, Reed (13) in reporting on a 16-year apricot pruning experiment concludes that heavy heading (short pruning) is best since it results in stronger trees with less limb breakage and larger-sized fruit. His results show, however, a moderate reduction in yield compared with long pruning.

DEFINITION OF TERMS

In the literature on pruning there is some confusion as to the exact meaning of such terms as "cutting back", "thinning out", and "short" pruning. In order to ensure a clear understanding of the meaning of terms as used in this report, the following definitions are presented:—

Shoot.—A one-year-old terminal growth.

Branch.—A growth two years of age or older.

Cutting back.—Reduction in the length of shoots or branches.

Thinning out.—Reduction in the number of shoots or branches.

Long pruning.—Thinning out of shoots or branches without cutting back.

Short pruning.—Cutting back of shoots to about half their length, accompanied by thinning out of shoots and branches.

Medium pruning.—Light cutting back of shoots, accompanied by thinning out of shoots and branches.

PROCEDURE

A three-acre block of land sloping gently to the north was selected as the site of a combined soil maintenance and pruning experiment with peaches and apricots. The soil is a sandy loam underlaid with coarse gravel at a depth of about 18 inches. Alfalfa hay had been produced on this land for a period of five years. The sod was ploughed under in the autumn of 1924 preparatory to planting the trees in the spring of 1925, so that at the start of the experiment the soil was well supplied with both organic matter and nitrogen.

The orchard was planted in three one-acre blocks, each of which received a different soil management treatment. One block was cover cropped continuously with hairy vetch, the second received clean cultivation with an annual application of ten tons of manure, and the third clean cultivation with an annual application of 600 pounds of 4-8-12 fertilizer. In each block half of the trees were spaced 20 by 20 feet on the square and half were planted 30 by 30 feet with a tree in the centre of each square.

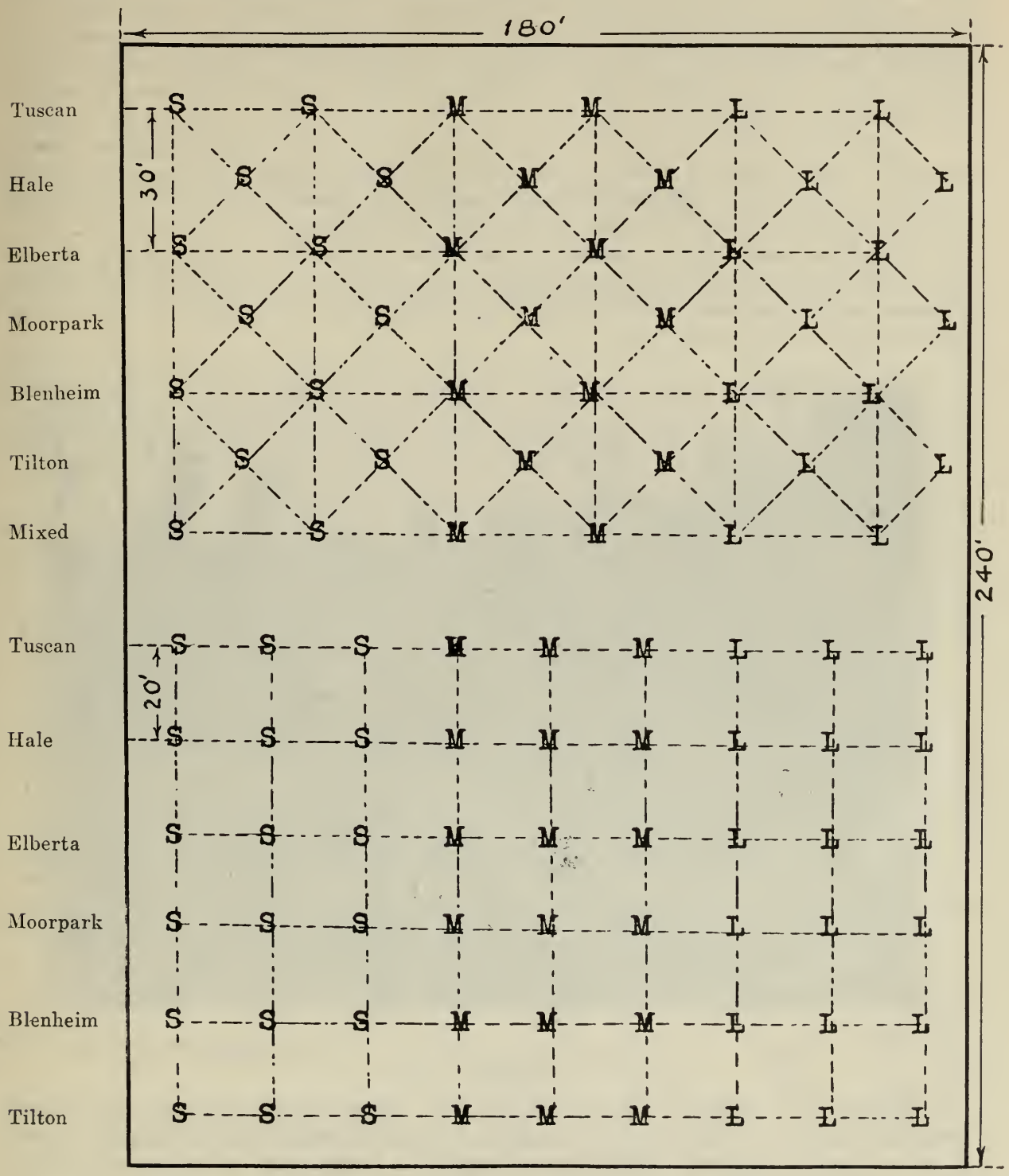

FIG. 1.—Planting Plan, Fertilizer Block. "S" indicates, short, "M" medium. and "L" long pruning.

Each half-acre block contained one row each of Elberta, J. H. Hale, and Tuscan Cling peaches, and Tilton, Blenheim, and Wenatchee Moorpark apricots. Within each row equal numbers of trees received each method of pruning, viz.,

long pruning, involving heavy thinning out of shoots and branches with no heading back; short pruning, involving heavy heading back as well as thinning out; and medium pruning, consisting of light heading back as well as thinning out. Buffer rows were planted at the east and west ends of the orchard.

This planting plan resulted in economy of operation since regular tillage implements could be used in the comparatively large soil management blocks. Operations such as thinning, spraying, and harvesting were facilitated by having the varieties in complete rows. Furthermore, the systematic distribution of varieties and pruning methods throughout the orchard minimized the possibility of error due to variability in soil fertility and supply of irrigation water. The distribution of the varieties and pruning treatments in the chemical fertilizer block is shown in Fig. 1.

Regardless of the method of pruning practised, all pruning was done during the early spring, and an attempt was made to develop strong frameworks of the modified-leader type. Actually many peach trees developed open centres due to the tendency of side branches to suppress the leaders.

Irrigation water was applied by the furrow method as shown in Fig. 2. In the fertilizer block the short-pruned trees were closest to the delivery flume, whereas in the manure block they were in the middle of the rows, and in the vetch block at the lower end.

FIG. 2.—Irrigation water being applied by the furrow method to the fertilizer block in the spring of 1930.

Sprays were applied when necessary to control such pests as peach twig borer and aphids. Peaches were thinned to about 6 inches and apricots to about 2 inches apart. Several pickings were made to ensure full development of the fruit and harvesting at the optimum stage of maturity for fresh shipment. Production records were kept separately for each tree.

Growth measurements were made during the winter months. The trunk circumference of each tree was measured one foot from ground level and average shoot growth for each tree was determined by measuring ten typical terminal shoots distributed around the perimeter of the tree and well exposed to sunlight.

RESULTS

Method of Presentation

Records of twig growth, trunk diameter, and yield were secured for each tree each year. However, for the sake of brevity the results are presented for three periods only; the first from 1925 to 1930, the second from 1931 to 1934, and finally the entire period 1925 to 1934. Since peaches and apricots grow quickly and come into bearing early, the trees may be considered young for the first six years ending 1930, and mature for the period 1931 to 1934.

In analysing the results secured it was considered advisable to eliminate a few trees because of limb breakage, frost injury, and the occasional location of a tree on a gravel knoll. The numbers of trees of each variety from which results were calculated for each pruning and soil maintenance treatment are shown in table 1.

TABLE 1.—NUMBER OF TREES OF EACH VARIETY INCLUDED IN EACH PRUNING AND SOIL MAINTENANCE TREATMENT

Variety	Pruning treatments			Soil maintenance treatments		
	Long	Medium	Short	Fertilizer	Manure	Vetch
Tuscan	16	15	18	19	14	16
Hale	9	11	12	11	11	10
Elberta	15	16	18	16	17	16
Moorpark	14	14	15	17	15	11
Blenheim	12	13	15	17	11	12
Tilton	14	11	14	14	13	12

Only when the material was statistically comparable or when averages suggested significant experimental differences was it considered necessary to calculate probable errors. Where differences were very small, it was obvious from the amount of variation present that calculation of errors would yield no positive information. Errors were calculated according to Bessel's method which increases the probable error where the number of variants is less than 20.

Effects of Soil Maintenance Treatments

Growth and Yield, 1925-30.—The trunk cross-sectional areas of the six-year-old trees grown under different soil treatments are given in table 2. It is evident that, at six years of age, trees in the manure block had grown significantly larger than trees in the fertilizer block. With all varieties except Tuscan peach, the vetch block had produced trees intermediate in size between those in the manure and fertilizer blocks.

TABLE 2.—EFFECT OF SOIL TREATMENTS ON TRUNK CROSS-SECTIONAL AREA, AS AT 1930

Variety	Trunk cross-sectional area per tree			Odds that trees are significantly larger in manure block than in fertilizer block
	Fertilizer block	Manure block	Vetch block	
	sq. in.	sq. in.	sq. in.	approx.
Tuscan	35·7 ± 1·2	41·2 ± 1·6	32·0 ± 1·5	216 : 1
Hale	22·4 ± 0·9	26·8 ± 0·6	24·5 ± 1·4	175 : 1
Elberta	29·3 ± 1·4	44·2 ± 1·7	36·5 ± 1·5	434,782 : 1
Moorpark	23·7 ± 1·1	33·1 ± 1·4	31·7 ± 1·1	1,350 : 1
Blenheim	33·5 ± 1·3	49·5 ± 0·9	42·8 ± 3·1	α
Tilton	32·4 ± 1·1	42·7 ± 1·0	33·0 ± 2·1	434,782 : 1

The effects of soil treatment upon yield in the period 1925-30 are given in table 3. Taking all varieties together the average yield in the manure block was nearly double that in the fertilizer block. These data provide striking evidence of the desirability of adding some kind of organic matter to the soil where peaches and apricots are being grown.

The last column of table 3 shows an interesting comparison of the yielding performance of the varieties of peaches and apricots used in these experiments. It will be noted that the Elberta and Hale peaches greatly outyielded the Tuscan, and that the Wenatchee Moorpark apricot gave a materially greater yield than the Blenheim and Tilton varieties.

TABLE 3.—EFFECT OF SOIL TREATMENT UPON YIELD, 1925-30

Variety	Average yield per tree			Odds that yields in manure block are significantly higher than in fertilizer block	Average yield per tree in the three blocks
	Fertilizer block	Manure block	Vetch block		
	lb.	lb.	lb.	approx.	lb.
Tuscan	69±12·3	213±33·8	161±21·4	142 : 1	140
Hale	295±27·1	426±38·7	331±20·6	15 : 1	351
Elberta	207±15·0	604±36·5	330±26·3	α	385
Moorpark	162±10·1	221±15·0	167±12·4	37 : 1	184
Blenheim	118± 7·7	188± 8·8	120±11·0	19,230 : 1	138
Tilton	133±11·8	164±18·2	120±14·1	2 : 1	140

Yield, 1931-34.—Separate yield data have been calculated for the period 1931-34 inclusive, to indicate the yielding capacity of mature trees under different methods of soil management. These results are presented in table 4. Considering the average yield of all varieties the effect of continued annual applications of manure as compared with use of chemical fertilizer was to increase cropping 50 per cent. In this period the yield of the vetch block was only slightly higher than that of the fertilizer block, probably because with continued cropping of the trees and gradual killing out of the vetch cover crop by shading, the nitrogen supply necessary for forming a large healthy leaf surface and abundant new shoot growth was becoming deficient.

TABLE 4.—EFFECT OF SOIL TREATMENT UPON YIELD, 1931-34

Variety	Average yield per tree			Odds that yields are significantly higher in manure than in fertilizer block	Average yield per tree in the three blocks
	Fertilizer block	Manure block	Vetch block		
	lb.	lb.	lb.	approx.	lb.
Tuscan	402±36·2	690±67·4	610±34·3	95 : 1	552
Hale	679±33·4	825±35·8	759±36·0	22 : 1	753
Elberta	574±39·6	1,250±47·0	786±37·7	α	877
Moorpark	389±21·2	486±28·8	392±19·2	13 : 1	423
Blenheim	339±17·4	450±17·2	280±16·7	520 : 1	352
Tilton	439±27·4	506±26·5	362±29·4	3 : 1	438

Growth and Yield, 1925-34.—In 1934, trunk, height, spread, and twig growth measurements were taken for all the trees involved in the experiment. A summary of the average trunk cross-sectional areas of trees grown under different

soil treatments is shown in table 5. It is evident from these data that trees in the fertilizer block had consistently smaller trunks than trees in the manure and vetch blocks. The difference in trunk cross-sectional area of trees receiving manure and those receiving fertilizer, taking all varieties together, was 35 per cent.

TABLE 5.—EFFECT OF SOIL TREATMENT UPON TRUNK CROSS-SECTIONAL AREA AS AT 1934

Variety	Trunk cross-sectional area per tree			Odds that trees are significantly larger in manure than in fertilizer block	Average yield per tree in the three blocks
	Fertilizer block	Manure block	Vetch block		
	sq. in.	sq. in.	sq. in.	approx.	sq. in.
Tuscan	46·1±2·31	57·2±2·49	46·0±1·97	31 : 1	49·2
Hale	26·4±0·93	30·6±2·68	31·2±1·27	2 : 1	29·4
Elberta	38·3±1·65	57·9±2·42	49·0±1·84	19,230 : 1	48·6
Moorpark	30·5±1·18	43·7±1·90	44·4±2·54	19,230 : 1	38·7
Blenheim	46·4±1·83	65·4±2·44	67·0±3·65	19,230 : 1	57·9
Tilton	42·2±1·93	55·7±2·57	50·2±3·04	216 : 1	49·2

With regard to height of the different lots of trees it is interesting to observe from table 6 that only small differences existed after the trees had been growing for a period of ten years. Trees in the manure and vetch blocks grew taller than trees in the fertilizer block, but not to a statistically significant extent.

TABLE 6.—EFFECT OF SOIL TREATMENT UPON HEIGHT OF TREE AS AT 1934

Variety	Average height per tree		
	Fertilizer block	Manure block	Vetch block
	ft.	ft.	ft.
Tuscan	18·8	20·1	20·4
Hale	14·3	16·1	15·4
Elberta	16·5	17·7	18·4
Moorpark	16·1	17·3	18·4
Blenheim	20·1	20·0	21·1
Tilton	17·9	19·4	20·5

Spreads of the different trees presented in table 7 likewise fail to show any significant differences. In this connection, however, it is possible that spreads on large trees may have been reduced in some degree by crowding.

TABLE 7.—EFFECT OF SOIL TREATMENT UPON SPREAD, AS AT 1934

Variety	Average spread per tree		
	Fertilizer block	Manure block	Vetch block
	ft.	ft.	ft.
Tuscan	18·4	20·6	18·9
Hale	16·8	17·3	18·2
Elberta	18·3	22·5	21·7
Moorpark	18·2	20·9	22·1
Blenheim	21·7	24·8	24·8
Tilton	21·2	22·9	22·3

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From table 8 it may be seen that annual twig growth in 1934 was not greatly or consistently influenced by differential soil treatments, although twig growth tended to be smaller in the fertilizer block than in the manure or vetch blocks. Greater twig growth of Blenheim apricot in the vetch block than in either the fertilizer or manure blocks is difficult to explain. It will be noted that regardless of soil treatment, average annual twig growth had become undesirably short in all varieties by the time the trees reached the age of ten years.

TABLE 8.—EFFECT OF SOIL TREATMENT UPON SHOOT GROWTH DURING 1934

Variety	Average length of terminal shoots		
	Fertilizer block	Manure block	Vetch block
	in.	in.	in.
Tuscan	12·5	10·5	10·4
Hale	2·3	4·8	3·4
Elberta	4·4	4·4	6·8
Moorpark	4·0	5·9	6·0
Blenheim	7·6	7·0	12·4
Tilton	7·2	9·2	9·9

Average yields per tree for the period 1925-34 for the three different types of soil management are given in table 9. Taking all varieties together, total yields were approximately in the ratio 5:4:3 for manure, vetch, and fertilizer treatments, respectively. Calculated statistically, the odds are significant for four out of the six varieties in favour of manure as compared with commercial fertilizer treatment.

TABLE 9.—EFFECT OF SOIL TREATMENT UPON YIELD, 1925–34

Variety	Average yield per tree			Odds that yields are significantly larger in manure than fertilizer block
	Fertilizer block	Manure block	Vetch block	
	lb.	lb.	lb.	
Tuscan	413±36·2	661± 68·5	814±83·2	332 : 1
Hale	806±52·4	950± 45·4	1,062±54·7	44 : 1
Elberta	672±44·7	985±161·0	1,577±71·6	α
Moorpark	441±20·0	481± 26·4	590±35·2	78 : 1
Blenheim	355±58·3	333± 18·2	512±18·5	9 : 1
Tilton	465±29·4	407± 36·0	561±39·7	4 : 1

Economic Value of Soil Treatments.—The manure, vetch, and fertilizer blocks each consisted of one acre of 96 trees. From the average yields per tree for all varieties in each block shown in table 9, total yields per acre from 1925-34 have been computed. The returns from this fruit have been calculated on the basis of an average price for the ten years of 3 cents per pound. Approximate costs of the different soil treatments, allowing four dollars a ton for manure, have been subtracted from the gross returns to give the net returns.

These data are given in table 10. They indicate that in spite of the high cost of the manure applied, greatest net returns were secured from this method of soil maintenance. Nearly as good results were obtained with a vetch cover

TABLE 10.—EFFECT OF CULTURAL TREATMENTS UPON COSTS AND RETURNS 1925-34

Value, cost, and returns	Fertilizer block	Vetch block	Manure block
	$	$	$
Gross value of crop	1,575	1,908	2,559
Cost of soil treatment	135	50	400
Net returns	1,440	1,858	2,159

crop treatment, while returns from the commercial fertilizer treatment were lowest. Increase in returns from the manure block over the fertilizer block was approximately 50 per cent. This can be attributed largely to the fact that application of fertilizer without provision for maintenance of organic matter failed to provide the favourable soil conditions required to enable the chemical fertilizer to produce the results which would ordinarily be expected from it. Depletion of organic matter in the fertilizer block finally injured the soil texture to the extent that moisture-absorbing and retaining powers were materially impaired.

Effects of Distance of Planting

The two distances of planting, 20 by 20 feet and 30 by 30 feet with a tree in the centre of the square, described under "Procedure", resulted in spacing at the rate of 108 and 84 trees per acre respectively. The effect of these distances of planting on tree size at the end of the ten-year period of growth is shown in table 11.

TABLE 11.—EFFECT OF DISTANCE OF PLANTING ON TRUNK CROSS-SECTIONAL AREA AS AT 1934

Variety	Average trunk cross-sectional area	
	84 trees per acre	108 trees per acre
	sq. in.	sq. in.
Tuscan	54·9	44·4
Hale	27·7	30·0
Elberta	51·1	49·5
Moorpark	42·6	36·0
Blenheim	60·2	56·3
Tilton	56·2	41·9

It will be noted that with all varieties except the Hale peach, the wider spacing resulted in trees of larger size as indicated by average trunk cross-sectional area. With regard to Hale it may be stated that this variety is naturally a small-growing tree and accordingly may well be planted closer than the other varieties included in this experiment.

The effects of distance of planting on average yield per tree and per acre over the ten-year period are shown in table 12.

TABLE 12.—EFFECT OF DISTANCE OF PLANTING UPON YIELD, 1925–34

Variety	Yield per tree		Yield per acre	
	84 trees per acre	108 trees per acre	84 trees per acre	108 trees per acre
	lb.	lb.	lb.	lb.
Tuscan	785	489	65,940	52,812
Hale	821	964	58,964	104,112
Elberta	1,175	965	98,700	104,220
Moorpark	576	455	48,384	49,140
Blenheim	405	399	34,020	43,092
Tilton	583	419	48,972	45,252

From the data presented in table 12, it is evident that with all varieties except the Hale peach, wider spacing resulted in greater average yields per tree. However, when computed on an acre basis, the wider planting produced materially lower average yields with Hale, Elberta, and Blenheim; higher average yields with Tuscan; and similar yields to close planting with Moorpark and Tilton. Thus the larger per-tree yield in the wide-planted block was offset by the greater number of trees in the close-planted block to the extent that distance of planting caused no significant difference in yield per acre over the ten-year period.

In view of the fact that reduction in the number of trees per acre results in a reduction in costs of planting and maintaining an orchard, the results of this experiment suggest that there is nothing to be gained by planting more than 84 peach or apricot trees to the acre, even if the orchard is to be maintained for a period of only ten years. The small-growing J. H. Hale peach is an exception with which close planting may be justified. Where it is planned to crop the trees over a longer period, a spacing of 25 feet apart on the square involving only 70 trees per acre may be preferable to closer planting with strong-growing varieties such as the Elberta peach and Blenheim apricot.

Effects of Pruning Treatments

Under "Definitions" and "Procedure" brief mention has already been made of the three pruning methods which were studied in this investigation. In this section the effects of these three methods of pruning on growth and production of the different varieties are presented.

Growth and Yield, 1925-30.—By 1930, at the end of the sixth year's growth, it was possible to evaluate the influence of pruning upon the young trees during their formative period of growth.

Size of tree as measured by trunk cross-sectional area is given in table 13, for long, medium, and short pruning. These data indicate that at six years of age there was little if any correlation between trunk size and pruning treatment.

TABLE 13.—EFFECT OF PRUNING UPON TRUNK CROSS-SECTIONAL AREA AS AT 1930

Variety	Trunk cross-sectional area per tree		
	Long pruning	Medium pruning	Short pruning
	sq. in.	sq. in.	sq. in.
Tuscan	36·5	35·2	36·7
Hale	24·7	24·7	24·2
Elberta	40·3	32·7	38·0
Moorpark	27·8	28·7	30·2
Blenheim	42·7	38·6	40·9
Tilton	37·0	34·4	34·2

Photographs were taken of all three varieties of peaches and apricots before and after pruning. These photographs give a clear idea of tree response to

pruning methods. However, because of the large number of pictures involved, representative photographs of only two varieties are presented, namely, Wenatchee Moorpark apricot and J. H. Hale peach. These appear as Figs. 3 to 8.

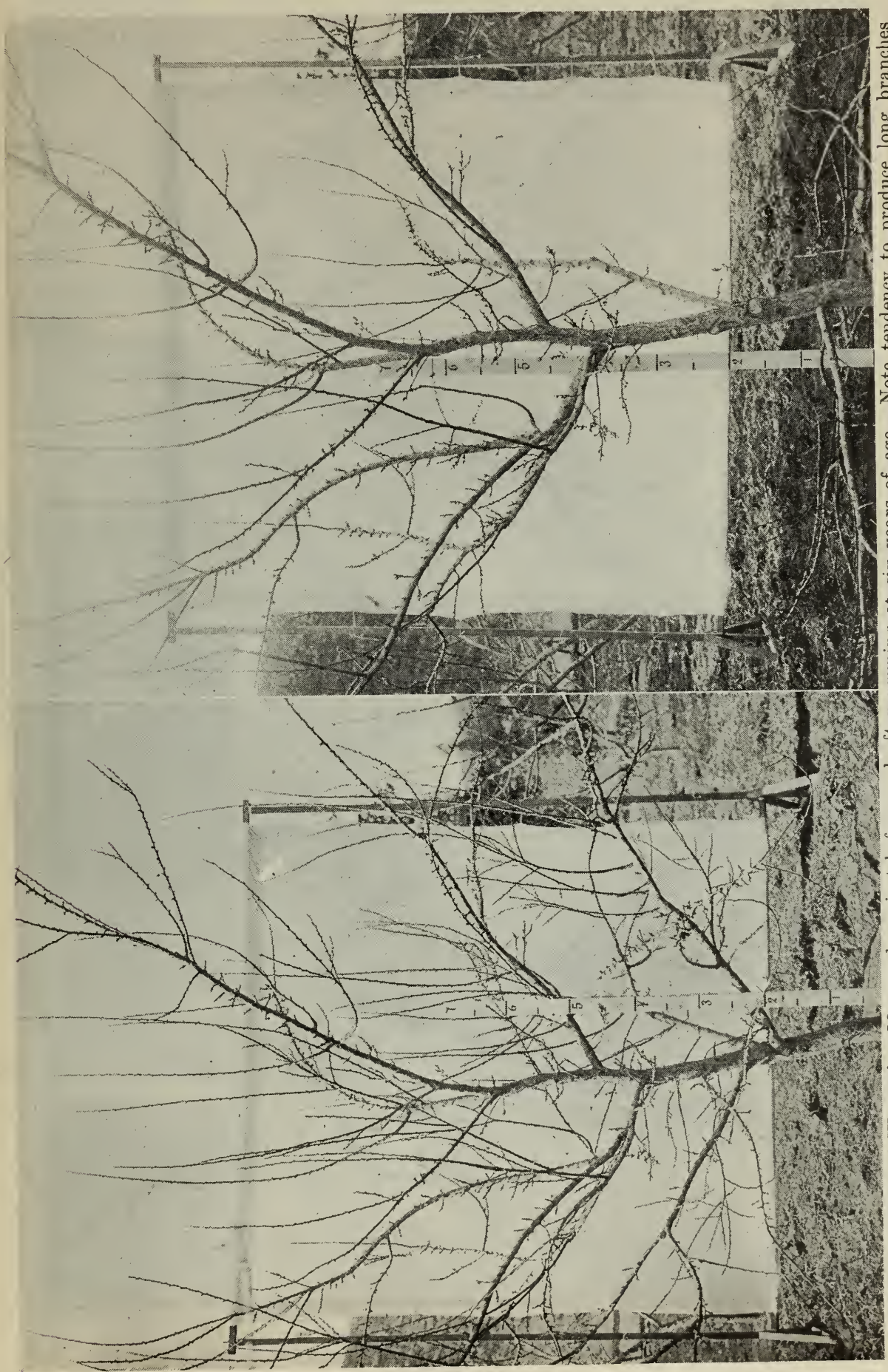

FIG. 3.—Long-pruned Wenatchee Moorpark apricot before and after pruning at six years of age. Note tendency to produce long branches well furnished with fruiting spurs.

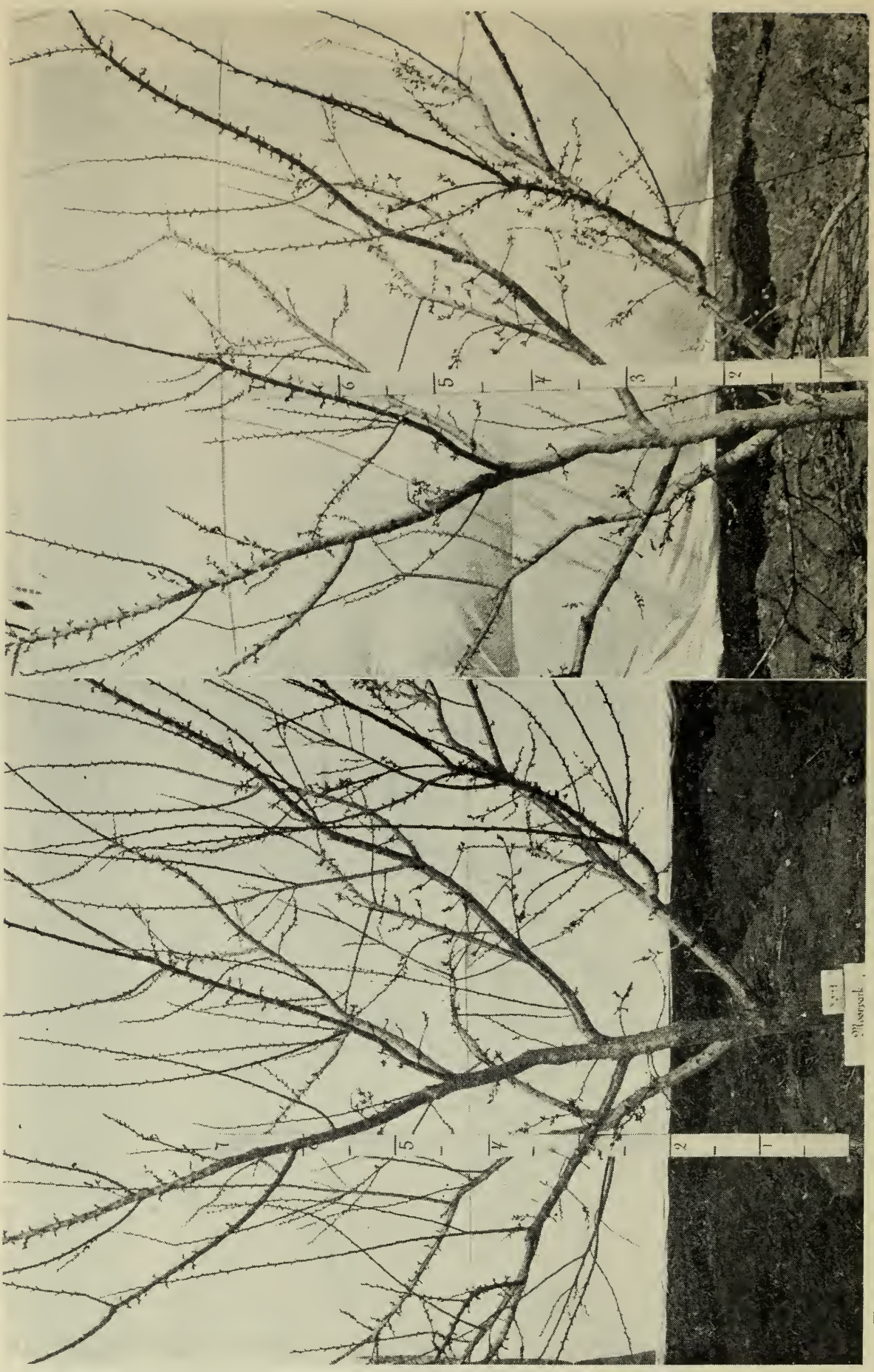

FIG. 4.—Medium-pruned Wenatchee Moorpark apricot before and after pruning at six years of age. Note strong framework and good distribution of branches.

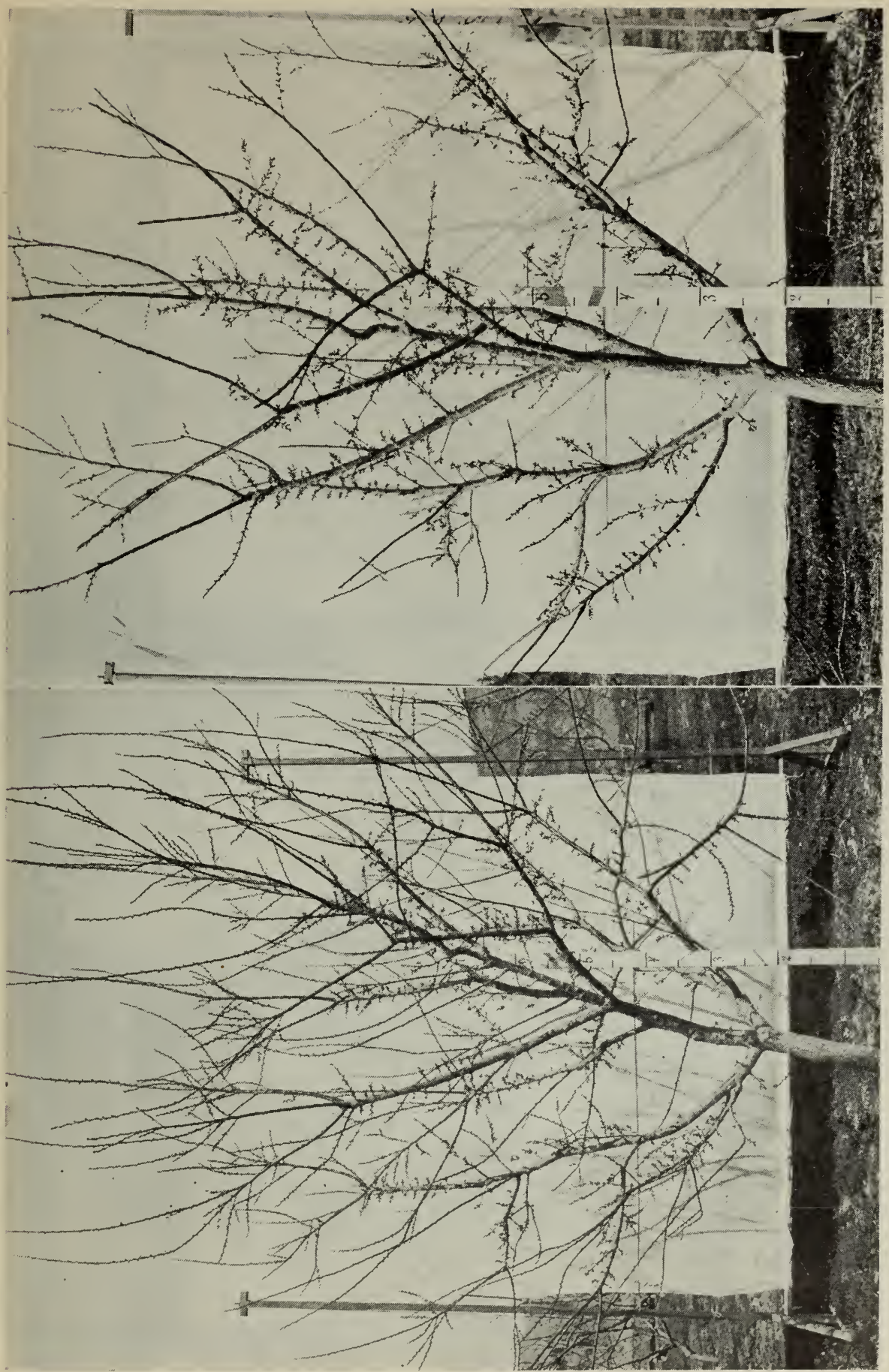

FIG. 5.—Short-pruned Wenatchee Moorpark apricot before and after pruning at six years of age. Note dense shoot growth induced by this type of pruning.

FIG. 6.—Long-pruned J. H. Hale peach before and after pruning at six years of age. Pruning consisted of thinning out of shoots and branches without any cutting back.

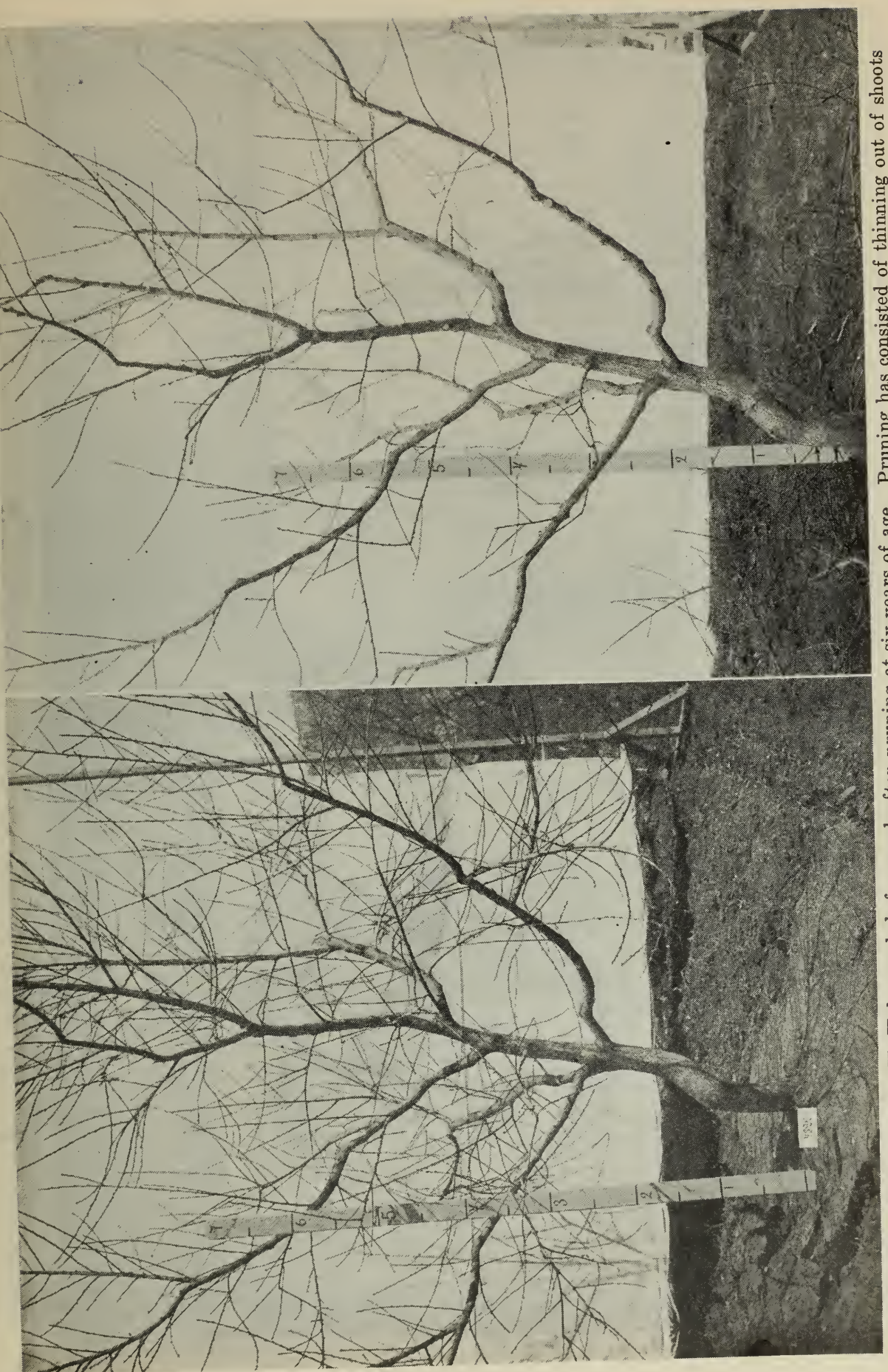

FIG. 7.—Medium-pruned J. H. Hale peach before and after pruning at six years of age. Pruning has consisted of thinning out of shoots and branches with light cutting back.

FIG. 8.—Short-pruned J. H. Hale peach before and after pruning at six years of age. Pruning has consisted of thinning out of shoots and branches, and heading back of shoots.

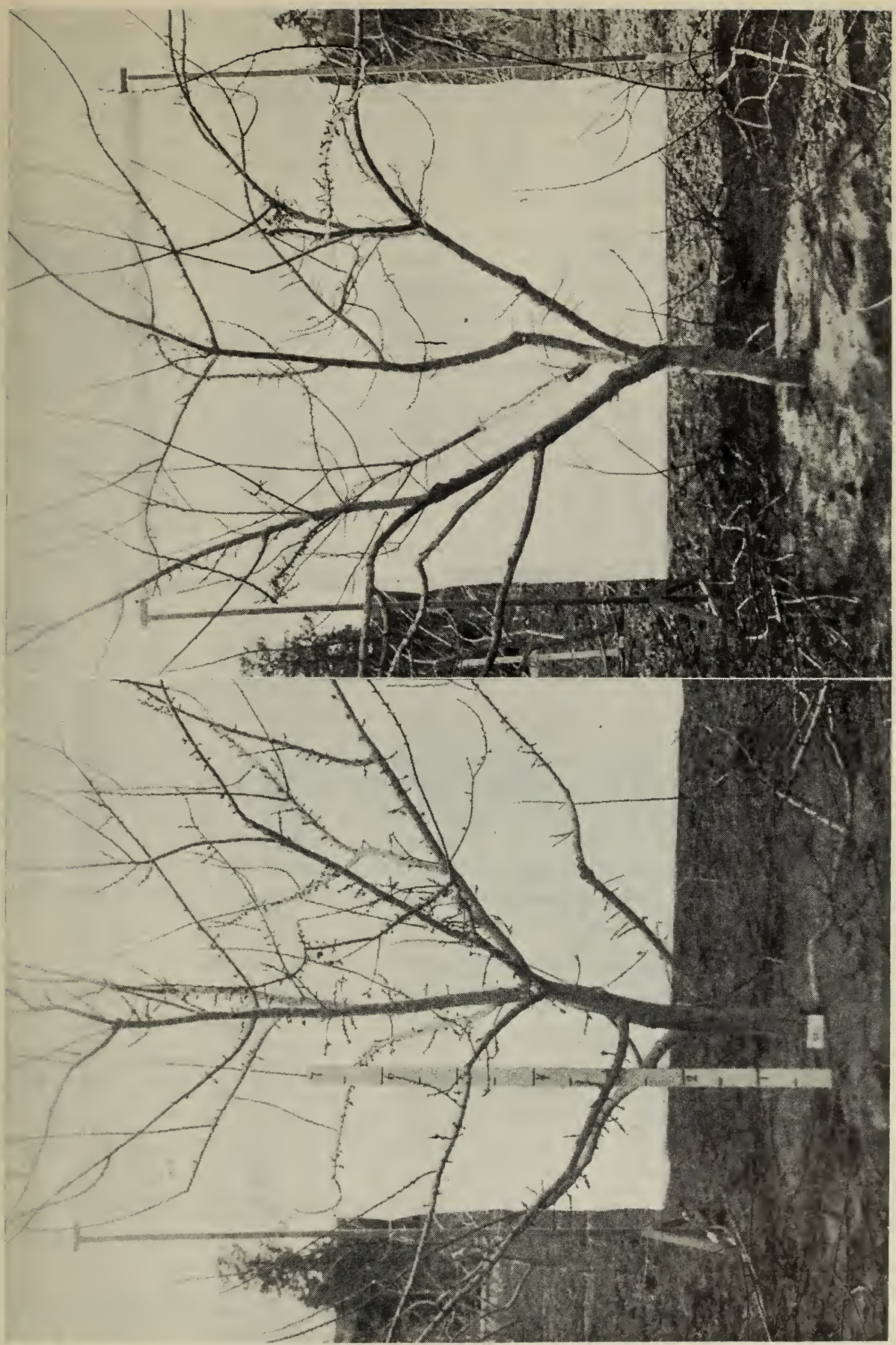

FIG. 9.—Long-pruned Tilton and Blenheim apricots after pruning at six years of age. Note sturdy, compact framework of Tilton compared with slender weak branches of Blenheim.

The three types of pruning produced distinct types of tree framework in both peaches and apricots. With long pruning there was a tendency toward development of long somewhat slender branches carrying a good distribution of fruiting wood. The structure of the resulting trees was strong in all varieties, but with the Blenheim apricot the branches were more willowy than is desirable as shown in figure 9. Medium pruning produced sturdy, well-built frameworks in all varieties. Short pruning resulted in profuse growth of new shoots and suckers necessitating removal of much more wood and consequently greater expense than medium or long pruning.

The influence of different types of pruning on yield during the period 1925-30 is shown in table 14. It will be noted that long pruning and medium pruning gave increased yields over short pruning. Although the differences are not significant with every variety, the average of the yields of all varieties indicates that long pruning resulted in 63·5 per cent greater yield than short pruning in the first six years of the tree's life.

TABLE 14.—EFFECT OF PRUNING UPON YIELD, 1925-30

Variety	Average yield per tree		
	Long pruning	Medium pruning	Short pruning
	lb.	lb.	lb.
Tuscan	213	193	32
Hale	411	392	269
Elberta	509	347	315
Moorpark	191	183	179
Blenheim	153	159	108
Tilton	173	140	105

Yield, 1931-34.—Yields during the years 1931-34 inclusive, have been totalled to determine the effects of long, medium, and short pruning upon the productivity of trees of full bearing age. From table 15 it is evident that with these full bearing trees, type of pruning had practically ceased to exert a significant influence on yielding capacity. While there still appeared to be a slight advantage in long pruning over short pruning in yield, the differences in yield were not significant.

TABLE 15.—EFFECT OF PRUNING UPON YIELD, 1931-34

Variety	Average yield per acre		
	Long pruning	Medium pruning	Short pruning
	lb.	lb.	lb.
Tuscan	638	654	391
Hale	659	742	753
Elberta	971	684	972
Moorpark	380	411	477
Blenheim	351	352	352
Tilton	489	434	413

Growth and Yield, 1925-34.—In 1934, trunk, height, spread, and shoot-growth measurements were taken for all the trees in the experiment. In table 16 are found the average trunk cross-sectional areas for the differently pruned trees. These data show no significant correlation of trunk size with pruning treatment.

TABLE 16.—EFFECT OF PRUNING ON TRUNK CROSS-SECTIONAL AREA AS AT 1934

Variety	Average trunk cross-sectional area per tree		
	Long pruning	Medium pruning	Short pruning
	sq. in.	sq. in.	sq. in.
Tuscan	43·7	49·3	54·1
Hale	30·9	27·5	30·1
Elberta	55·5	43·9	47·0
Moorpark	38·5	34·7	46·9
Blenheim	55·8	56·6	60·6
Tilton	53·7	46·2	47·0

The effect of long, medium, and short pruning on heights of the different varieties is shown in table 17. Here also there is no significant correlation of height with pruning treatment.

TABLE 17.—EFFECT OF PRUNING UPON HEIGHT OF TREE AS AT 1934

Variety	Average height of tree		
	Long pruning	Medium pruning	Short pruning
	ft.	ft.	ft.
Tuscan	20·2	19·1	19·7
Hale	16·3	14·9	15·5
Elberta	19·1	16·5	17·2
Moorpark	17·2	16·9	17·2
Blenheim	20·2	20·0	20·8
Tilton	20·1	18·0	19·2

In table 18 are shown the effects of method of pruning on the spread of the trees. The figures presented are averages of the north-south, east-west spreads of the trees of each variety.

TABLE 18.—EFFECT OF PRUNING UPON SPREAD OF TREE AS AT 1934

Variety	Average spread of tree		
	Long pruning	Medium pruning	Short pruning
	ft.	ft.	ft.
Tuscan	19·3	19·3	19·0
Hale	19·4	17·1	16·0
Elberta	23·6	20·5	18·9
Moorpark	21·0	20·5	18·8
Blenheim	24·0	23·8	22·9
Tilton	23·5	22·4	20·4

These data show slight but insignificant increases in spread of the trees with long and medium pruning over short pruning.

The shoot growth data obtained by measuring the trees in the fall of 1934 are presented in table 19. It will be seen that with the exception of Moorpark every variety was putting out a greater length of new shoot growth where short pruning rather than medium or long pruning was being practised. In fact taking all varieties together, short-pruned trees produced an average of 67·7 per cent longer shoot growth than long-pruned trees.

TABLE 19.—EFFECT OF PRUNING UPON SHOOT GROWTH DURING 1934

Variety	Average growth per shoot		
	Long pruning	Medium pruning	Short pruning
	in.	in.	in.
Tuscan	6·4	9·2	17·7
Hale	2·9	3·1	4·2
Elberta	3·8	4·4	7·0
Moorpark	5·6	4·8	5·0
Blenheim	7·2	8·0	10·8
Tilton	7·8	6·5	11·5

Average yields per tree for the period 1925-34 have been calculated and are given in table 20. These data show that slightly increased yields were obtained with long pruning over medium and short pruning with peaches, particularly with Tuscan Cling variety. With apricots, highest yields were obtained with short-pruned Moorparks and long-pruned Tiltons, while type of pruning did not seem to influence yielding capacity of trees of the Blenheim variety to any appreciable extent.

TABLE 20.—EFFECT OF PRUNING UPON YIELD, 1925–34

Variety	Average yield per tree		
	Long pruning	Medium pruning	Short pruning
	lb.	lb.	lb.
Tuscan	765	750	405
Hale	999	975	854
Elberta	1,283	907	1,087
Moorpark	474	485	546
Blenheim	392	425	365
Tilton	544	477	416

Although differences in tree size were not great between ten-year-old trees which had received the three pruning treatments, nevertheless there were marked differences in tree form to be observed between long- and short-pruned trees. Short pruning resulted in trees of denser and more compact form than long pruning. These differences in form are well exemplified by two Tilton trees photographed at nine years of age. (Fig. 10.)

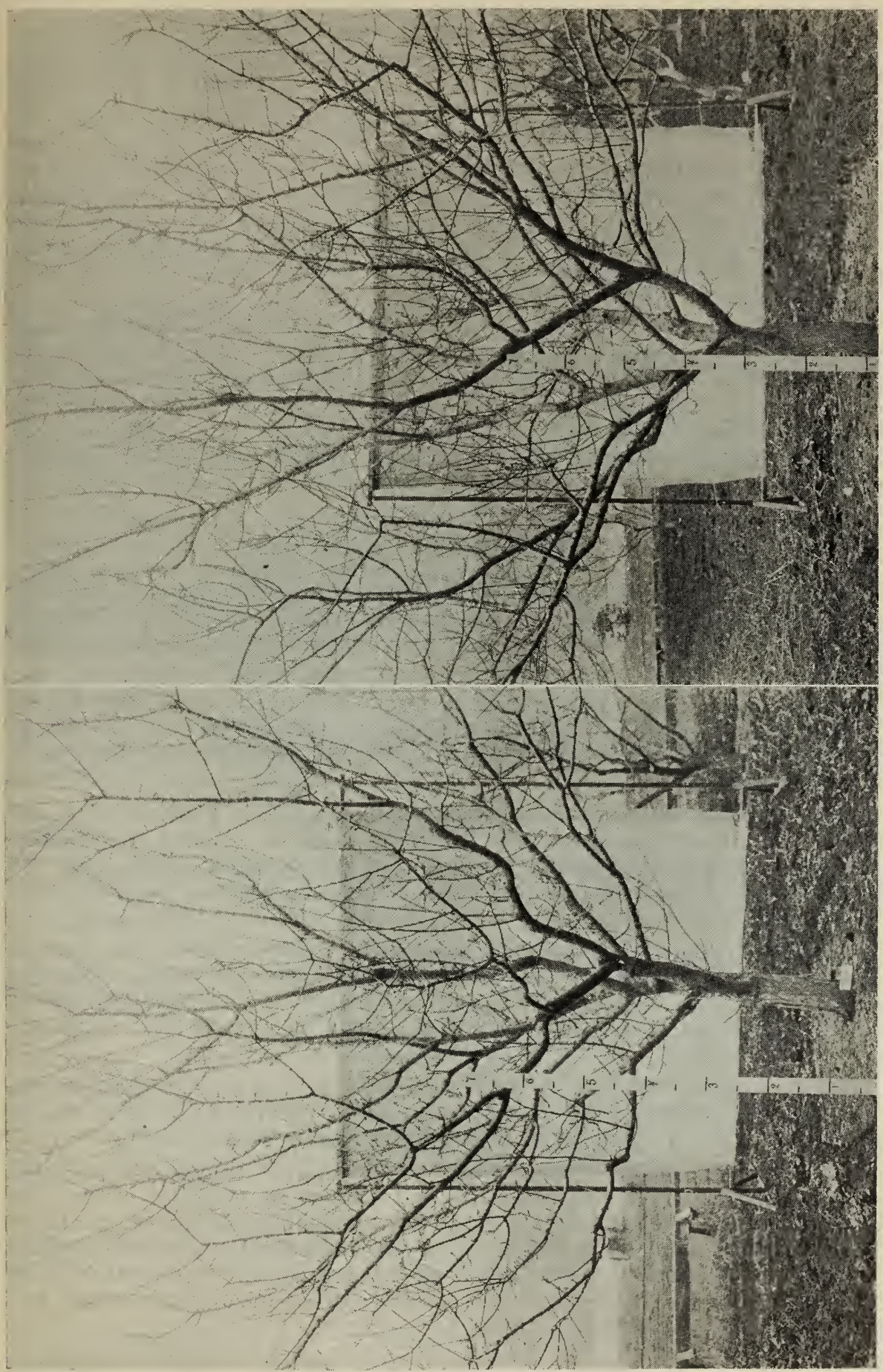

FIG. 10.—Short-and long-pruned Tilton apricots before pruning at nine years of age. Note undesirably dense habit produced in this variety by short pruning.

DISCUSSION

The superior growth and cropping performance of trees receiving manure or vetch cover crop treatment as compared with those receiving clean cultivation and chemical fertilizers in this experiment supports the findings of previous investigators that humus and nitrogen are very important factors in maintaining vigour and productivity in peach and apricot orchards.

The delay in bearing brought about by short as contrasted with medium or long pruning, is in conformity with results reported by Blake (2), Chandler (4), Cullinan (7), Gourley (8), Tufts (16, 17), and Schrader and Auchter (14). Furthermore, the fact that there was little difference in the total yield of long-, medium-, and short-pruned trees when they had reached ten years of age is in agreement with the findings of Cullinan (7).

The fact that the shoot growth of short- as well as medium- and long-pruned trees tended to be shorter than desirable at the close of the ten-year period suggests that these methods of pruning as defined in this report were not sufficiently severe to maintain satisfactory vigour under the conditions of this experiment. This is in conformity with the recommendations of Tufts (16) and Howard (9) who advocate drastic cutting back and thinning out of branches when the trees show signs of diminishing vigour.

RECOMMENDATIONS

The results of this experiment together with information secured from the literature and from observation in commercial orchards, suggest the following general recommendations for the culture and pruning of peaches and apricots in the Okanagan Valley.

Maintenance of the soil in a state of high fertility, especially with respect to humus and nitrogen, is essential. These two elements of fertility can be economically supplied by the use of leguminous cover crops such as hairy vetch and sweet clover.

It is advisable to build up the soil as much as possible while the trees are young as in later years growth of the cover crops is reduced by shading. Furthermore, cover crops provide harbour for the tarnished plant bug, the activities of which cause malformed fruits, making it necessary to disk under the cover crop in the autumn each year after the trees reach bearing age.

Good results have been secured with sweet clover sown at the rate of 15 pounds per acre with a drill on a firm seed-bed in very early spring. Seeding broadcast and harrowing to cover the seed can be resorted to if no seed-drill is available. However, whatever method of seeding is used, it is most important that the seed-bed be firm.

Hairy vetch can be sown to advantage either in late July or early spring, at the rate of 25 pounds per acre. If a crop is permitted to ripen seed it frequently provides a volunteer stand for several years thereafter.

Even where leguminous cover crops are grown it is usually advisable to supplement them with barnyard manure and nitrogen in chemical form. The amount of manure to apply depends somewhat on availability and price. However, even where manure costs as much as five dollars per ton at the orchard, it is advisable to apply at least ten tons per acre every three years. It is usually most convenient to apply the manure during the winter months and disk under early in the spring.

Additional nitrogen can be furnished in the form of ammonium sulphate. The amount to apply should be judged by the colour of the foliage and length

of terminal growth. Sufficient should be used so that in conjunction with the pruning methods employed, an average terminal growth of about 18 inches is maintained. This may require only one or two pounds per tree for orchards just coming into bearing and as much as ten pounds per tree for mature orchards.

With regard to pruning methods, a " long " system involving severe thinning out of branches and no cutting back of one-year wood can be expected to give good results with most varieties of peaches and apricots during the first six or seven years. This type of pruning encourages development of an extensive framework which carries a good distribution of fruiting wood promoting early and heavy bearing. However, it is not advisable to adhere slavishly to any one system of pruning, but rather to modify the type of pruning to conform with the requirements of the variety and the individual tree. Thus with the Blenheim apricot which tends to produce long willowy branches, some cutting back of one-year wood is desirable. Similarly, in the treatment of individual trees of any variety some cutting back may be required to maintain balance between branches and develop a strong symmetrical framework.

After the trees reach maturity and heavy cropping tends to reduce their vigour, cutting back into two- or three-year-old wood may be necessary to encourage production of strong new fruiting wood.

The importance of an optimum combination of distance of planting, soil management, and pruning cannot be overestimated. Too close planting, inadequate supplies of organic matter or nitrogen, and insufficient pruning, tend to produce weak growth with consequent low yields of poor quality fruit. On the other hand too wide spacing reduces per-acre yield during the early years of production; too heavy pruning increases costs of operation and delays bearing; and too much nitrogen tends to prolong growth with consequent poor quality fruit and danger of winter injury. A planting distance of 25 feet on the square combined with intelligent soil management and sufficient pruning to produce an average terminal growth of about 18 inches in mature trees can be expected to give satisfactory results.

SUMMARY

Attention is drawn to the importance of soil fertility and pruning in maintaining vigour and productivity in peach and apricot trees. Literature on this subject is briefly reviewed. Terms used in describing methods of pruning are defined. A comprehensive experiment involving three acres of land, three methods of soil management, three methods of pruning, and three varieties each of peaches and apricots is described.

The methods of soil management used were continuous cover cropping with hairy vetch, clean cultivation with an annual application of ten tons of manure per acre, and clean cultivation with an annual application of 600 pounds per acre of 4-8-12 fertilizer. The pruning methods employed were long, short, and medium, as defined in the report. The varieties tested were Elberta, J. H. Hale, and Tuscan Cling peach, and Blenheim, Tilton, and Wenatchee Moorpark apricot.

The results secured over a ten-year period are presented in tables and illustrated with photographs. The conformity of these results with data reported in the literature is discussed and practical recommendations made.

The more important findings may be briefly stated.

1. During the first six years of this experiment, trees receiving manure were much larger than those growing with vetch cover crop, or receiving fertilizer, and produced greatly increased crops.

2. From the seventh to the tenth year the trees in the manure block maintained their superiority in size over trees given other treatments, showing a 35 per cent increase in trunk cross-sectional area over trees in the fertilizer block. In height and spread, however, the differences were not significant.

3. From the sixth to the tenth year, yields from trees in the manure block continued to be greater than those from trees receiving the other two treatments.

4. During the complete ten-year period yields for the three different soil treatments were in the ratio of 5:4:3 for manure, vetch, and fertilizer treatments, respectively.

5. Despite the relatively high cost of manure, this treatment gave the highest net returns, closely followed by vetch cover crop treatment. Returns from clean cultivation plus fertilizer were the lowest.

6. Planting at the rate of 84 trees per acre tended to produce larger trees and greater yields per tree than planting at the rate of 108 trees per acre. However, the effects of these two planting distances on yields per acre were neither consistent nor significant.

7. During the first six years from planting, greatly increased yields were secured by long pruning, especially with peaches.

8. However, at the end of this period, tree size was similar regardless of pruning treatment.

9. From the sixth to the tenth year, yields on the short- and medium-pruned trees increased and became equal to those of long-pruned trees.

10. Due to an initial delay in bearing, however, yields for the full ten-year period were not as great with short- and medium- as with the long-pruned trees.

11. At the end of the ten-year period the three lots of trees were not significantly different in size, although the vigour of new terminal growth was greater with short- than with medium- or long-pruned trees.

12. Long pruning proved to be a satisfactory method for developing sturdy trees and early bearing in all varieties tested except the Blenheim apricot, of which the slender habit of growth was better handled by some cutting back.

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