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Department of Horticulture

WINTER VERSUS SUMMER PRUNING of APPLE TREES

BY
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Winter Versus Summer Pruning of Apple Trees.

INTRODUCTION

The pruning of apple trees in winter to encourage wood growth and in summer to induce fruitfulness are principles that have long been recognized by horticulturists. It is surprising to learn in reviewing the literature that these principles are based on very meager experimental evidence; moreover the experimental evidence from different sources in many ways is contradictory.

There are no doubt many factors that influence the results obtained in different sections of the country. The writer is confident that the nature of both winter and summer pruning practiced influences the ultimate results. Results from pruning practices are influenced to a certain extent by such factors as soil, climate, age of trees, general health of trees, cultivation, irrigation, and thinning, and those factors must be considered in interpreting the results. The principal object of pruning operations should be insurance of maximum amounts of fruit without serious impairment of the general vigor of the trees.

To throw further light upon the relative value of winter and summer pruning of apple trees, the following report, based upon experiments conducted at the central station is presented.

HISTORY OF PRUNING EXPERIMENT

In 1905, Prof. L. B. Judson, then horticulturist of the experiment station, planted the orchard, in which the investigational work was conducted. The orchard is located at an elevation of approximately 2700 feet. It is at least 200 feet above the floor of the valley. The ground slopes to the north and east. The soil is the typical Palouse silt loam of the Palouse country; it is deep, friable, fine in texture, and well drained. This orchard is typical of many of the apple orchards in the northern part of the state where irrigation is not practiced. The annual precipitation varies from 20 to 25 inches.

Two year old trees, planted 32 feet apart each way, were used in starting this experiment. The experiment originally included eighty trees, equally divided among the following varieties: Jonathan, Rome, Grimes and Wagener. There were a few mixed varieties in both blocks, so it was necessary to abandon six trees. Wagener fillers were planted between the original Wagener trees in the fall of 1905, but these trees were not included in the data compiled.

For the first five years, after the trees were planted, clean cultivation was practiced in the orchard. During the summer of 1910, 1911 and 1912, onions were grown in portions of the orchard as an inter-crop. Manure has been used very liberally on the different plats from time to time. The soil is in a good state of fertility. Whenever clean cultivation was practiced, a good dust mulch was maintained during the spring and summer in order to conserve the moisture. The orchard was cultivated every ten days or two weeks during the growing season.

This orchard has given us an opportunity to study the effects of pruning on the development of the trees from the time of planting in 1905 until the present time.

OBJECT OF THE EXPERIMENT

The primary object of the experiment was the determination of the effect of winter vs. summer pruning upon the yield and color of the fruit. In order to study the problem, the orchard was divided into two blocks. The trees of one block were pruned

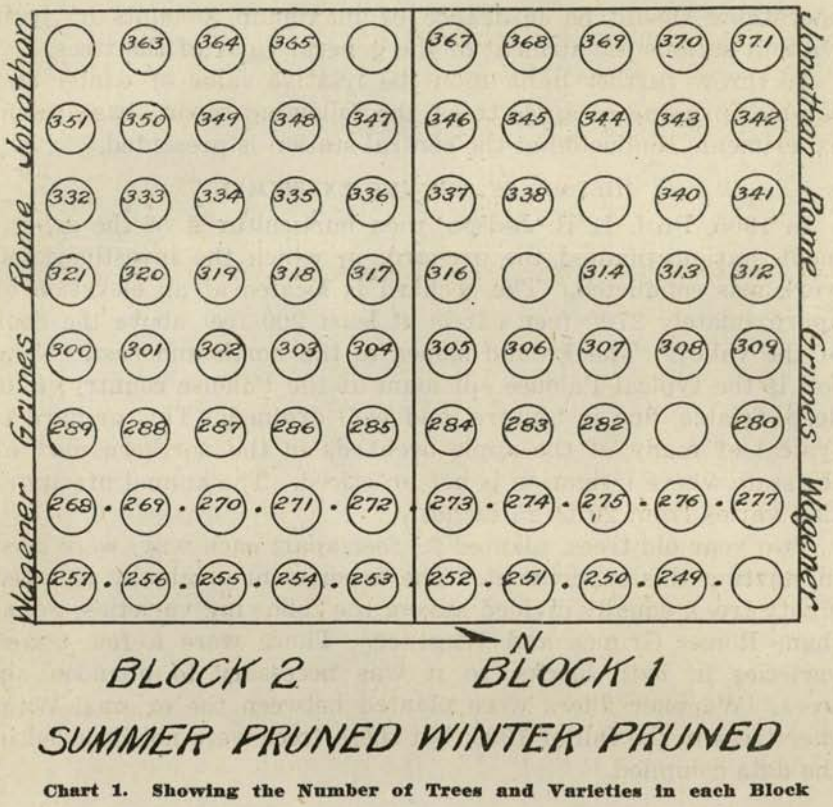

Chart 1. Showing the Number of Trees and Varieties in each Block

in the winter time and those of the other were pruned in the summer. There were approximately the same number of trees in each block. Chart No. 1 is a plan of the orchard, showing the location of the various varieties and the arrangement of the plats in each block.

PLAN OF WORK

The Winter Pruning: Block No. 1 consisting of Jonathan, Rome, Grimes and Wagener has been given a moderate annual pruning, during the dormant season from the time the trees were planted in 1905 until the present time. The method of pruning has been very similar to that followed by successful growers in the state. That is, the trees have been so developed that they will produce a good quality of fruit and at the same time ample wood to bear good crops without the aid of artificial supports. All trees were pruned to the open or vase shaped type.

During the first year the two year old trees were pruned back severely. From four to six scaffold limbs which formed the framework of the trees were allowed to remain. Two-thirds of the terminal growth were removed.

The second year, approximately one-half of the terminal growth was removed and from two to three branches left on each permanent scaffold limb.

The third year about one-third of the terminal growth was removed and crossing branches taken out.

From the third year on until the trees came into bearing in 1910, the aim has been to cut back a portion of the terminal growth and thin out.

After the trees came into bearing and up until the present time the practice has been to thin out the center to admit plenty of sunlight and free circulation of air, to keep all the lower branches out of the way of cultivation, and to keep the upper branches from growing out of reach for spraying and picking.

The Summer Pruning: Block No. 2 which contains the same varieties enumerated in the winter-pruned block, has received a moderate annual pruning during the summer, from the time the trees were planted until the present time. The trees in this block have never been pruned during the dormant season since planted. The method of pruning followed in this block has been the same as that followed in the winter-pruned block. Approximately the same amount of wood was removed in each case. The summer pruning was done after the terminal buds had set. The

work was performed at this time because the trees have practically finished their growth for the year.

If the summer pruning is done before the trees have ceased growing, adventitious buds will push out below the cuts, which results in a growth of shoots. On the other hand, if pruned too late in the season, no opportunity is given the buds to swell into fruit buds, which is one of the objects sought by summer pruning. Summer pruning is supposed to incite fruitfulness. The principle involved is that during the early summer much of the food is used by the tree in throwing out leaves and making new growth. By removing part of the growth at just the proper time, some of this reserve food material will be deposited in and behind the buds, causing them to form flower organs.

TABLE 1.—Showing When Plats Were Pruned Each Year.

Time of Pruning	1910	1911	1912	1913	1914	1915	1916
Winter	Mar. 20	Apr. 15	Mar. 25	Apr. 9	Mar. 12	Mar. 19	Mar. 16
Summer	Aug. 8	Aug. 7	Sept. 6	Aug. 19	Aug. 6	Aug. 24	Aug. 31

Fig. 1. Jonathan Tree after Winter Pruning in 1911.

The time of pruning during the summer influences the growth of shoots.

The correct time to summer prune cannot be determined by the calendar. The seasons vary from year to year. This is clearly brought out in the above table, which shows when the pruning was performed in both blocks during the past seven years.

AMOUNT OF WOOD REMOVED

As has been indicated, the object has been to remove, as far as practicable, approximately the same amount of wood in pounds each year from all plats. The uniformity of the trees in the orchard would indicate that an effort had been made to do so. It is to be regretted that no detailed records were kept of the actual weight of wood removed each year. We have data on this subject for the past two years, however, which is presented in the following table.

TABLE 2.—Showing Average Weight of Wood Removed per Tree.

Variety	Winter 1915-lbs.	Summer 1915-lbs.	Winter 1916-lbs.	Summer 1916-lbs.
Jonathan	32.4	30.4	59.22	54.8
Rome	26.0	28.2	33.43	45.7
Grimes	38.21	35.44	48.1	50.3
Wagener	17.62	16.0	23.4	19.2

A few large limbs which were beginning to crowd were removed from both blocks in 1916.

Fig. 2. Jonathan Tree after Winter Pruning in 1913.

GROWTH OF TREES

The vigor of the trees pruned at different seasons of the year can unquestionably be measured by the annual terminal growth, the height and width of the trees and the diameter of the trunks. In studying the vigor of trees, such factors as soil, cultivation, climate, elevation, size of crop, fertility, which have a very close relation to pruning must be considered. No one of them can secure satisfactory results alone. It is evident that with the trees under experimentation, not one of these various orchard operations have been neglected. Aside from pruning, both blocks have received practically the same treatment as far as orchard management is concerned. The growth, general vigor of trees, as indicated in the following tables in both the winter and summer pruned blocks has been fairly uniform in many respects.

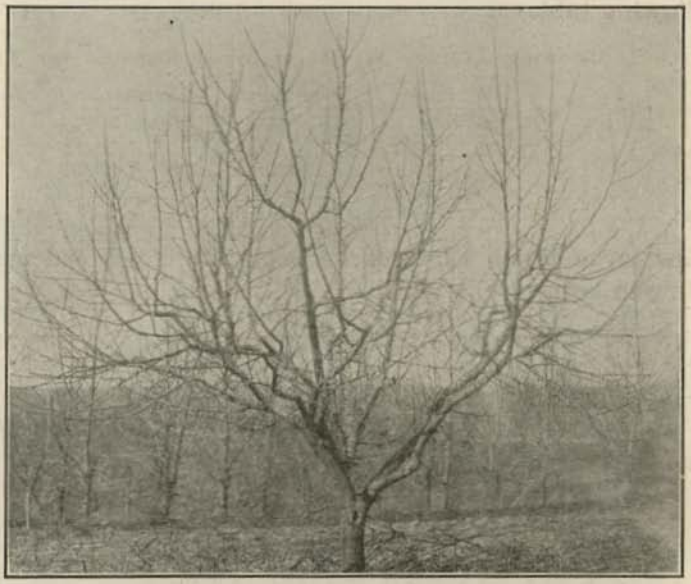

Fig. 3. Jonathan Tree after Winter Pruning in 1915.

TABLE 3.—Showing Average Terminal Growth per Tree in 1916.

Variety	Winter Pruned	Summer Pruned
	Inches	Inches
Jonathan	16.1	18.2
Rome	15.4	14.8
Grimes	12.7	16.2
Wagener	11.9	12.4

The above tabulations represent the average of one hundred measurements in each plat. With one exception the trees in the

summer-pruned plats made a larger terminal growth in 1916 than those in the winter-pruned plats. The Rome trees made .6 inches more growth when winter pruned than the same variety summer pruned.

What effect has the two methods of pruning had upon the height and width of the trees? After pruning a block of trees annually for the past eleven years in the summer, one would naturally wonder what effect such a practice would have upon the growth. Many practical growers are opposed to summer pruning because they feel that it is a devitalizing process.

In this experiment the pruning in the summer-pruned block took place after the terminal growth had stopped for the year. While tree growth as shown in the following table has been checked to a certain extent, the difference in most cases is very slight and could well come within the realm of chance. The writer is confident that summer pruning as practiced in this orchard has not seriously interfered with the nutrition of the plants.

Fig. 4. Jonathan Tree before Winter Pruning in 1916.

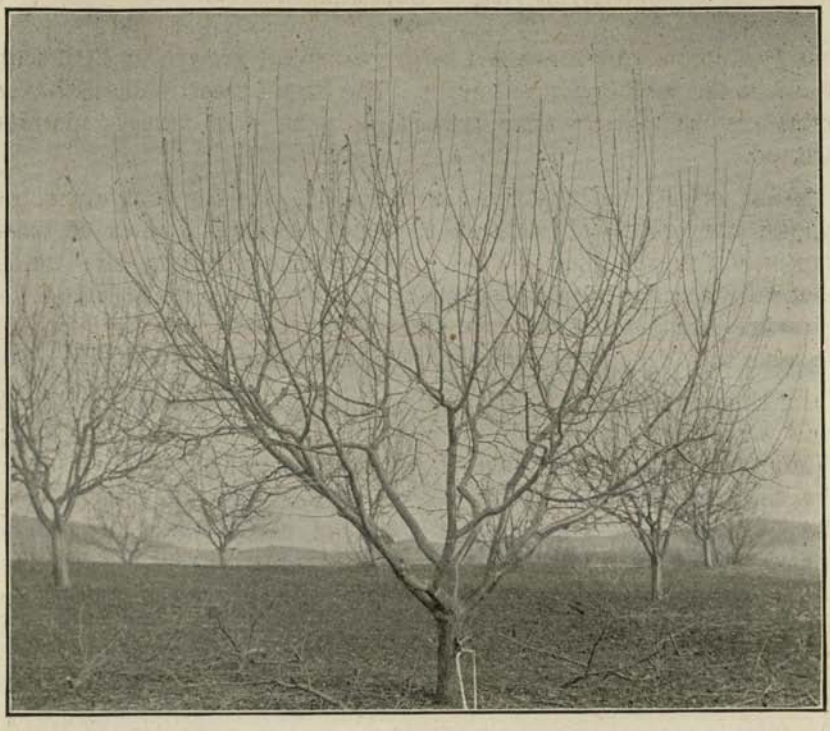

Fig. 5. Jonathan Tree after Winter Pruning in 1916. Same Tree as Shown in Fig. 4.

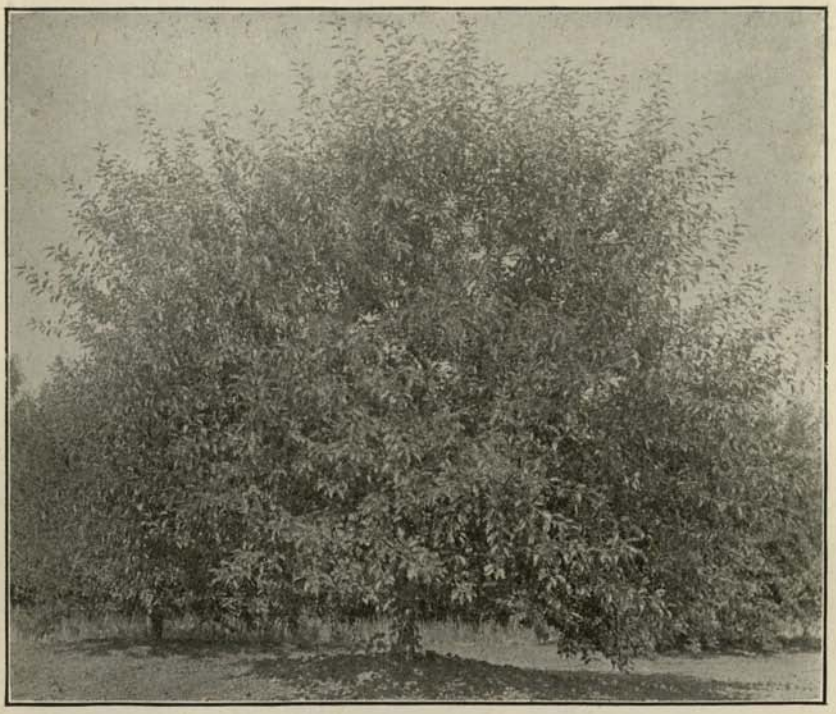

Fig. 6. Jonathan Tree before Summer Pruning in 1916.

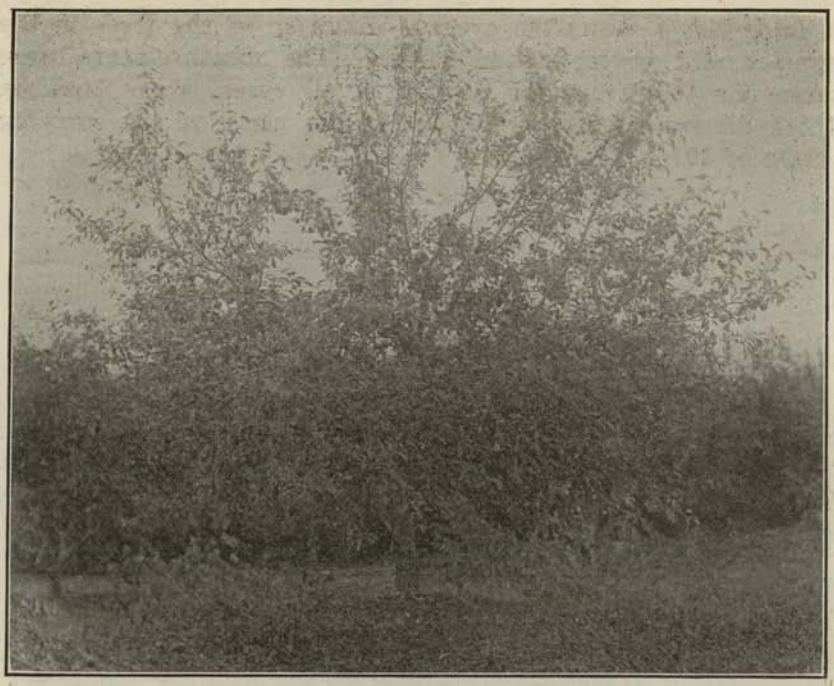

Fig. 7. Jonathan Tree after Summer Pruning in 1916. Same tree as shown in Fig. 6.

Careful measurements were made of the height and width of all trees in both blocks at the close of the season's growth in 1916.

TABLE 4.—Showing Average Height and Width of Trees.

Variety	Method of Pruning	Height in Feet	Width in Feet
Jonathan	Winter	17.24	19.51
	Summer	15.98	17.71
Rome	Winter	15.88	14.35
	Summer	15.75	13.6
Grimes	Winter	16.0	15.3
	Summer	15.38	14.67
Wagener	Winter	14.65	12.25
	Summer	14.30	12.95

The figures in the above table show the following gains in favor of the winter-pruned trees: Jonathan, height 15.12 inches, width, 21.6 inches; Rome, height 1.56 inches, width 9 inches; Grimes, height 7.44 inches, width 7.56 inches; Wagener, height, 3.48 inches. The only exception in the spread of branches was in the Wagener trees. Here we note a gain of 8.4 inches in favor of the summer-pruned trees. While there has been a very material increase in both height and spread of branches for the winter-pruned Jonathan, the differences in these particulars with the other varieties are not very marked.

Table No. 4 shows the average diameter of the trees in the summer and winter-pruned blocks. The measurements were taken one foot from the ground in all cases where possible. These dimensions were recorded at the close of the growing season of 1916.

TABLE 5.— Showing Average Diameter of Trees in Each Plat.

Variety	Winter Pruned	Summer Pruned
	Inches	Inches
Jonathan	7.43	7.35
Rome	6.58	6.56
Grimes	6.71	6.32
Wagener	5.82	5.61

The average diameter of the trees in the winter-pruned block was a trifle larger in each case than those in the summer-pruned block. The difference is insignificant in practically all cases. The actual gain is as follows: Jonathan, .08 inches; Rome, .02 inches; Wagener, .21 inches; and Grimes .39 inches.

Fig. 8. Rome Tree before Winter Pruning in 1916.

Fig. 9. Rome Tree After Winter Pruning in 1916. Same tree as shown in Fig. 8.

YIELDS

Early Bearing. It will be interesting now to compare the results of the two methods on early bearing. Summer pruning is supposed to cause trees to come into bearing earlier, but does not always give uniform and satisfactory results on all varieties. The benefits derived will depend largely upon the variety. The first crop of fruit was produced in the orchard in 1910.

TABLE 6.— Showing the Effect of Winter and Summer Pruning on Bearing

Variety	Winter Pruned			Summer Pruned		
	No. trees per plat	No. trees that fruited	Total yield pounds	No. trees per plat	No. trees that fruited	Total yield pounds
Jonathan	10	8	290	8	8	271.7
Rome	8	8	111.5	10	8	139.0
Grimes	9	7	119.0	10	9	200.0
Wagener	9	9	261.0	10	10	543.0

If measured by the number of trees that came into bearing in 1910, the above table shows that when all varieties are considered

Fig. 10. Rome Tree before Summer Pruning in 1916.

together 88.8 per cent of the trees in the winter-pruned block produced fruit, and 89.4 per cent bore fruit in the summer-pruned block. Looking at the question from the standpoint of variety, there appears to be no increase either way when the Wagener is considered. All trees in both plats came into bearing at the same time. Summer pruning in the case of the Jonathan and Grimes caused more trees to come into bearing. Considering the data from a crop standpoint, the eight Jonathan trees that fruited in the winter-pruned plat produced a total yield of 290 pounds as compared with 271.7 pounds from the same number of trees in the summer-pruned plat. The average yield per tree, when the total number of trees are considered throws the increase in favor of the summer-pruned trees as shown in Table 12. With the Rome, when number of trees is considered, the eight summer-pruned trees produced a larger crop than the winter pruned. There was no increase either way when the entire number of trees in each plat is compared. With the Grimes and Wagener, the summer-pruned trees yielded on an average more fruit.

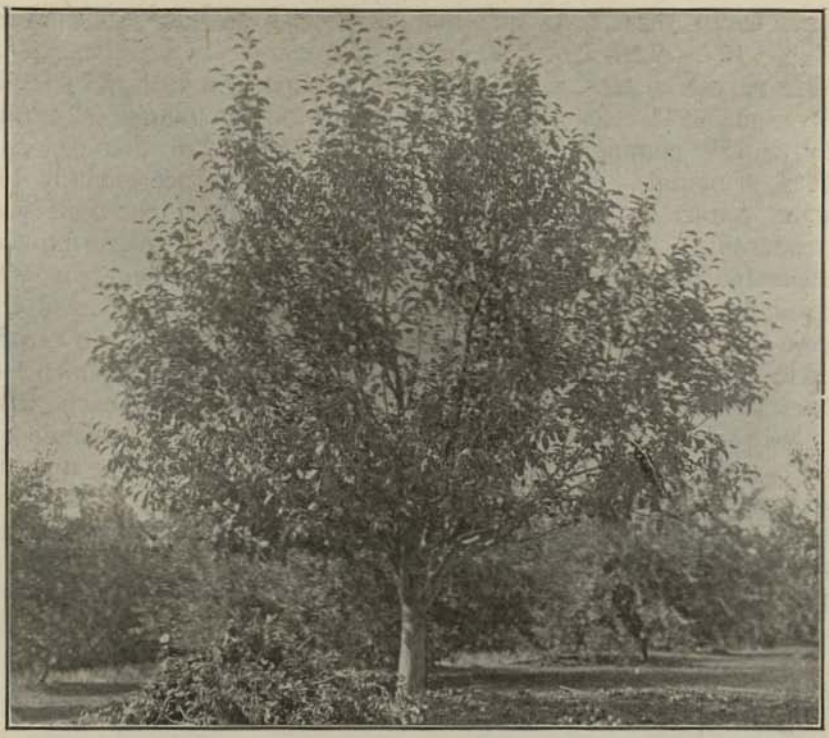

Fig. 11. Rome Tree after Summer Pruning in 1916. Same tree as shown in Fig. 10.

THINNING IN RELATION TO PRUNING AND CROP PRODUCTION

While pruning is in fact one method of thinning it does not entirely take the place of hand thinning. The thinning of fruit as a means of relieving the trees of exhaustion has undoubtedly a direct bearing upon crop production. It has been the object thruout this experiment to remove approximately the same number of apples after the June drop from each plat. Actual counts were made this last year only. The following table shows the number of apples thinned in each plat.

TABLE 7.— Showing Average Number of Apples Removed per Tree, 1916.

Variety	Winter Pruned	Summer Pruned
	Number of Apples	Number of Apples
Jonathan	521.9	435.5
Rome	211.2	270.1
Grimes	502.6	484.2
Wagener	356.5	345.0

The ill effects of leaving too many apples on certain individual trees is clearly demonstrated in Tables 8, 9, 10 and 11, which give the performance record of each tree in each plat for the

past seven years. As an example I wish to call attention in Table 10 to Tree No. 302, in the summer-pruned Grimes plat. This particular tree, as one will note, produced in 1910, 25 pounds of fruit; 1911, 108 pounds of fruit; 1912, 70 pounds of fruit; 1913, 327 pounds; 1914, 11 pounds; 1915, 226 pounds, and 1916, 0 pounds. This tree was allowed to produce entirely too many apples in 1913 with the result that very little fruit was produced in 1914. Summer pruning could not overcome the excessive drain placed upon the tree. Another large crop was produced in 1915. The crop that year completely exhausted the tree so that no fruit was produced in 1916. Contrast the record of this tree with the record of Tree No. 301. This tree which has been properly thinned has produced a uniform crop each year.

No record was kept as to the number of fruit buds pruned off each year in the winter-pruned plats. According to the amount of wood removed each year there should be a close correlation between the number of fruit buds removed in the winter-pruned plat and the number of apples pruned off in the summer-pruned plats.

There has been a gradual increase in the amount of wood re-

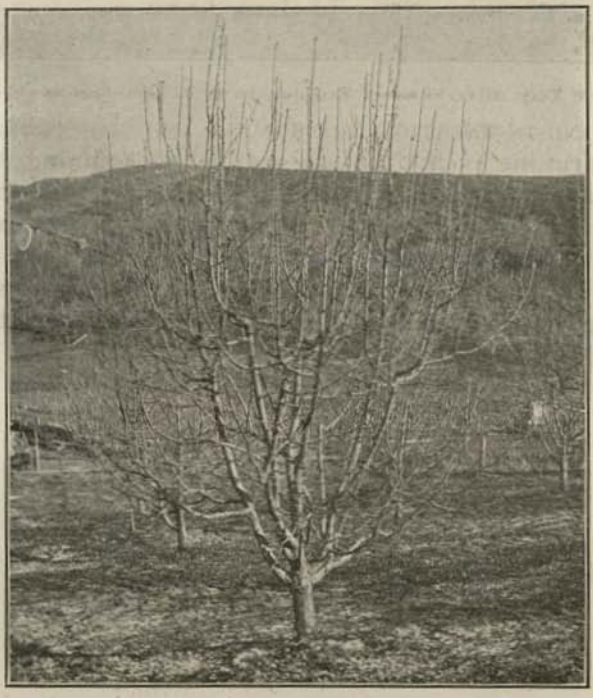

Fig. 12. Wagener Tree before Winter Pruning in 1916.

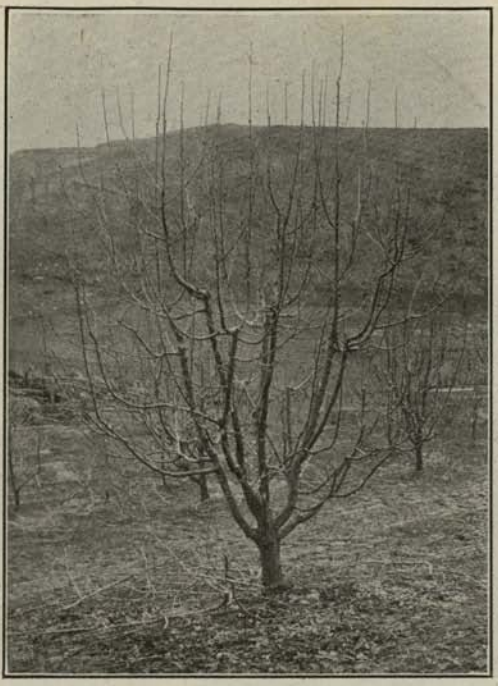

Fig. 13. Wagener Tree after Winter Pruning in 1916. Same tree as shown in Fig. 12.

Fig. 14. Wagener Tree before Summer Pruning in 1916.

Fig. 15. Wagener Tree after Summer Pruning in 1916. Same tree as shown in Fig. 14.

moved and the number of apples pruned off each year. During the summer of 1916, the average number of apples per tree pruned off was as follows: Jonathan 445; Rome 282.8; Wagener 182.1; Grimes, 324.7.

PERFORMANCE RECORD

A complete record of the yields of each individual tree in both blocks is given from the time the trees commenced bearing until the present time.

It would seem that yield of fruit for a period of years is a safe criterion to measure any method of orchard management. A comparison of pruning tests for several years, after the trees have come into bearing should throw some light upon the relative merits of the two methods. During this entire period there has been no total crop failure. However, in 1915, the frost reduced the crop on some varieties quite materially. A summary of the data given in Tables 8, 9, 10, 11 is presented in Table 12. The crop production for the past seven years, showing the average yield in pounds per tree for the four varieties under both methods of treatment is recorded.

TABLE 8.—Showing Yield per Tree in Pounds, Yearly, in Jonathan Plat.

Trees Winter Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
342	26.5	40.75	118	69	317	45	250
343	72.5	46.25	120	120	330	35	304
344	67.5	67	153	170	388	42	355.5
345	0	42	120	141	231	31	257
346	42	46.5	106	127	246	36	362
367	21	51	97	71	398	38	295
368	17.5	12	117	101	166	105	251
369	10	7.75	48	286	233	107	173.5
370	0	1	6	52	98	35	49
371	33	39	70.5	141	167	29	97

Trees Summer Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
347	48.5	37.5	135	258	198	79	397.5
348	17		66	229	237	59	188
349	25.5	6	75	139	235	9	211
350	76.5	31	150	101	311	89	266
351	22	31.5	85	79	342	90	312
363	19.5	2.5	67	67.5	182	37	279
364	48.5	16.25	152	158	345	37	328.5
365	14.2	24.75	34	123	167	14	195

TABLE 9.— Showing Yield per Tree in Pounds, Yearly, in Rome Plat.

Trees Winter Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
312	7.5	52	82	48	21	12	58
313	5	26.25	27	14	21	5	41
314	10	23	37	27	16	3	81
316	7.5	19.5	23	12	9	8	61
337	22	111	77	110	265	11	250
338	21.5	90	90	84	88	41	88
340	15	118	11	93	143	27	180
341	23	82.25	73	83	52	43	87

Trees Summer Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
317	16	35	27.5	122	15	12	44
318	9.5	14.5	18	34	46		61
319	0	22	33	32	17	4	77
320	9.5	45	106	158	119	35	208
321	0	0	45	95	106	31	219
332	21.5	35	65	8	125	41	247
333	34.5	44	103	119	158	41	291
334	15.5	42	87	117	106	11	227
335	16	34	74	98	37	7	119
336	16.5	28.5	27	67	72	24	111

TABLE 10.— Showing Yield per Tree in Pounds, Yearly, in Grimes Plat.

Trees Winter Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
280	0	50	85.5	14	109	15	80
282	26	61	12	156	110	199	79
283	0	64	88	21	149	15	297.5
284	0	0	41	14	127	16	239
305	12.5	69.5	3	213	111	177	231
306	18	51.5	193	14	124	10	385
307	13.5	94	112	194	147	189	193
308	23.5	96.25		190	35	280	14
309	25.5	63	147.25	99	247	18	258

Trees Summer Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
285	0	0	41	4	60	15	196
286	14.5	50	126	177	129	56	220
287	24	90	108	212	10	229	0
288	14.5	77	65	295	5	299	9
289	35.5	176	119	414	40	299	19
300	16.5	65	63	230	51	235	18
301	19.5	71	95	165	128	131	187
302	25	108	70	327	11	226	0
303	19.5	49	179	55	291	40	122
304	31	24.5	129.5	76	160	26	312

TABLE 11.—Showing Yield per Tree in Pounds, Yearly, in Wagener Plat.

Trees Winter Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
249	11	6	56	30	100	0	248
250	4.5	26	17	61	7	16	183
251	37	2	78	20	95	0	105
252	35	25.5	76	18	71	0	226
273	33.5	24.5	67	14	88	14	254.5
274	47.5	3.5	121	22	176	0	196
275	24	1.5	30.5	13	73	4	157
276	36	60	57	16	45	22	199
277	32.5	6	101	4	99	0	28.5

Trees Summer Pruned							
Tree No.	Yield in Pounds						
	1910	1911	1912	1913	1914	1915	1916
253	45	39.5	165	14	201	0	204
254	38	9	145	74	39	0	219
255	75	119	165	30	200	0	252
256	35.5	109.5	64	84	91	64	135
257	67	82	22	45	0	0	221
268	70.5	60	112	55	266	23	244
269	67.5	21	198	11	223	0	179
270	34	60	110	55	230	0	266
271	38.5	82	90	129	58	186	107
272	72	6	161	11	282	0	328

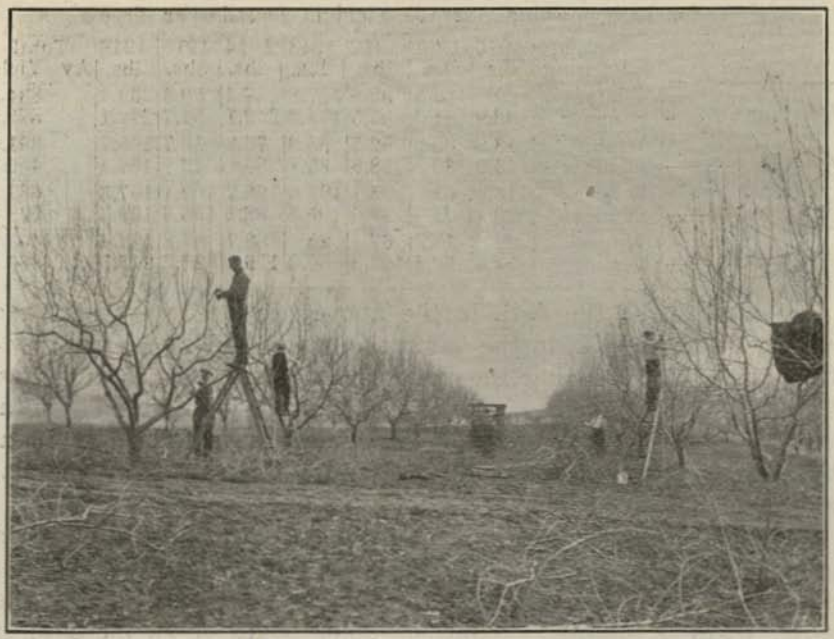

Fig. 16. General View of Winter Pruning in Jonathan Plat.

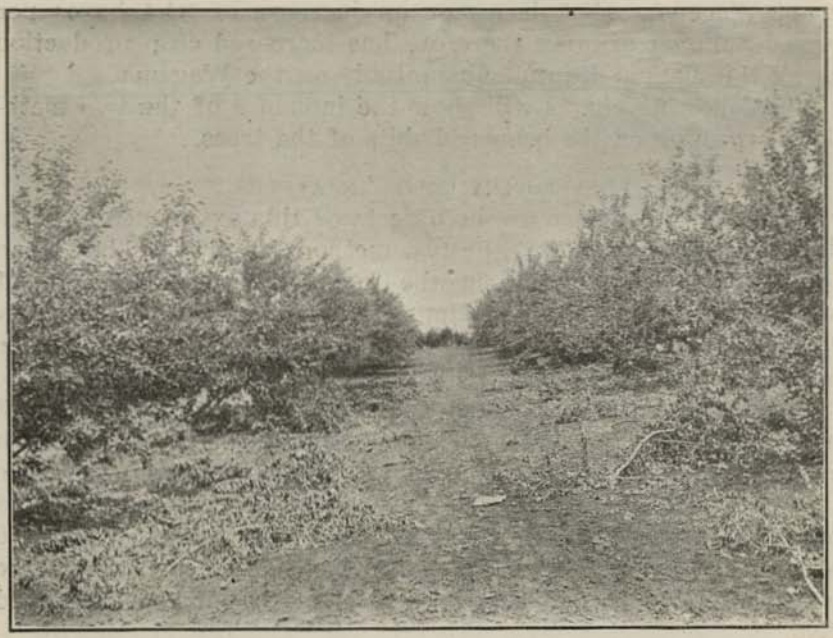

Fig. 17. General View of Summer Pruning in Jonathan Plat.

TABLE 12.— Showing Average Yield in Pounds per Tree

Variety	Time of Pruning	1910 lbs.	1911 lbs.	1912 lbs.	1913 lbs.	1914 lbs.	1915 lbs.	1916 lbs.	Total Av. Yield
Jonathan	Winter	29	35.3	95.5	127.8	257.4	50.3	239.4	834.7
	Summer	33.9	21.3	95.5	144.3	252.1	51.7	272.1	870.9
Rome	Winter	13.9	65.2	52.5	58.8	76.8	18.7	105.7	391.6
	Summer	13.9	30	58.5	85	80	23	160.4	450.8
Grimes	Winter	13.2	61	85.1	101.6	128.7	102.1	197.3	689
	Summer	20	71	99.5	195.5	88.5	155.6	108.3	738.4
Wagener	Winter	29	17.2	67	22	83.7	6.2	177.4	402.5
	Summer	54.3	59.4	123.2	50.8	159	27.2	215.5	689.4

An analysis of the data in the above table shows that there has been an increase in the summer-pruned block over the winter-pruned block during the past seven years for all varieties. The increase with some varieties has been very slight. The total average gain in favor of summer pruning is as follows: Jonathan, 36.2 pounds; Rome, 59.2 pounds; Grimes, 50.6 pounds; and Wagener, 286.9 pounds.

The trees were planted 32 feet apart each way which would give 42 trees per acre. If the entire orchard had been summer pruned there would have been an increase per acre during the seven years as follows: Jonathan, 30.02 boxes or an increase of 4.28 boxes per year; Rome, 49.7 boxes, or an increase of 7.1 boxes per year; Grimes, 50.6 boxes or an increase of 6.07 boxes per year; Wagener, 240.9 boxes or an increase of 34.4 boxes per year. Summer pruning therefore has increased crop production on all the plats and quite substantially on the Wagener.

The following charts will show the influence of the two methods of pruning on the bearing habits of the trees.

DEVELOPING COLOR IN APPLES

As stated before one of the objects of this experiment was to determine to what extent the two methods of pruning had upon the development of color in the apple. The development of higher color is an exceedingly important factor in the non-irrigated sections of the state. This is particularly true in that color plays such an important part in the marketing of the fruit.

From investigations conducted a few years ago in the east it was found that the trade demands high color in apples. In answer to a question as to whether color was of more importance than flavor it was found that fine color is considered to be of more importance than flavor in almost every market. Out of a total of 108 replies, 68 or 63 per cent considered fine color to be of more importance than flavor and 34 or 31 per cent answered "No."

There are certain conditions that will materially intensify color in fruit. On this subject, Professor W. T. McCoun, in

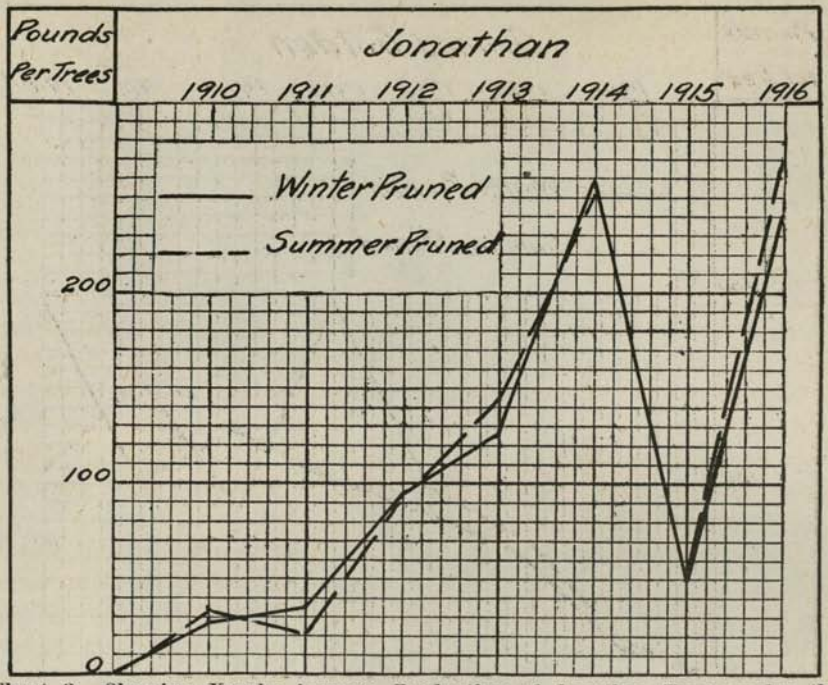

Chart 2. Showing Yearly Average Production of Jonathan Trees under the two Methods of Pruning.

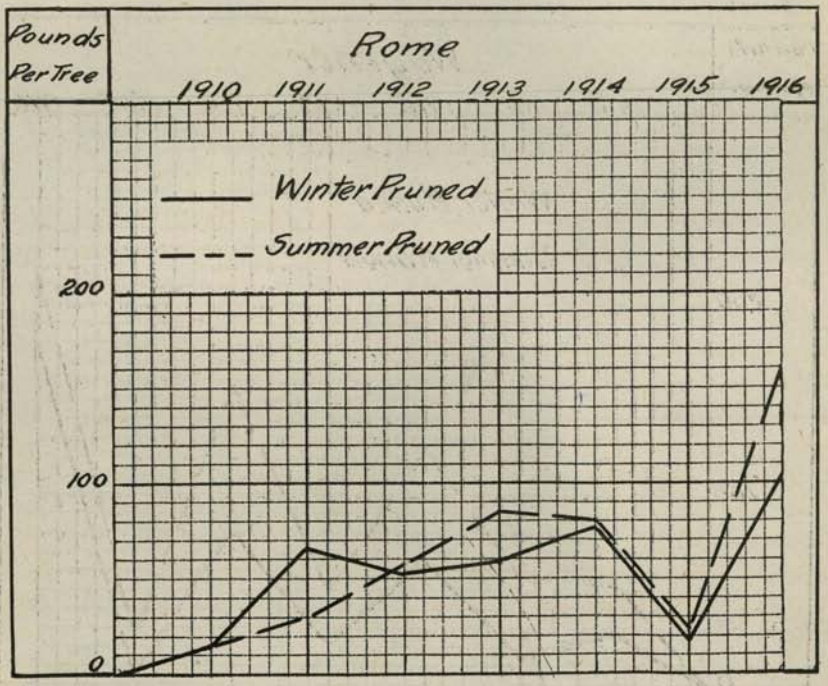

Chart 3. Showing Yearly Average Production of Rome Trees under the two Methods of Pruning.

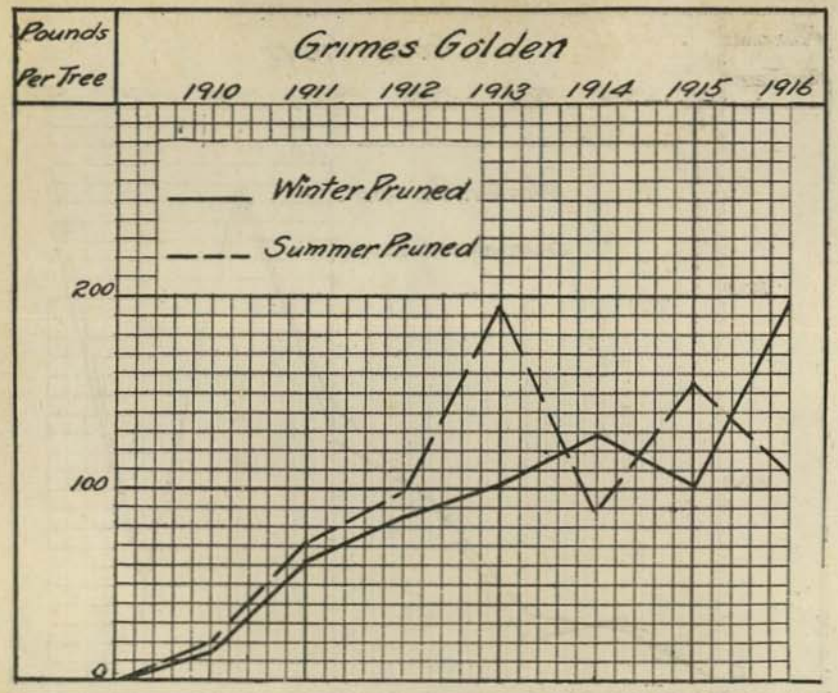

Chart 4. Showing Yearly Average Production of Grimes Trees under the two Methods of Pruning.

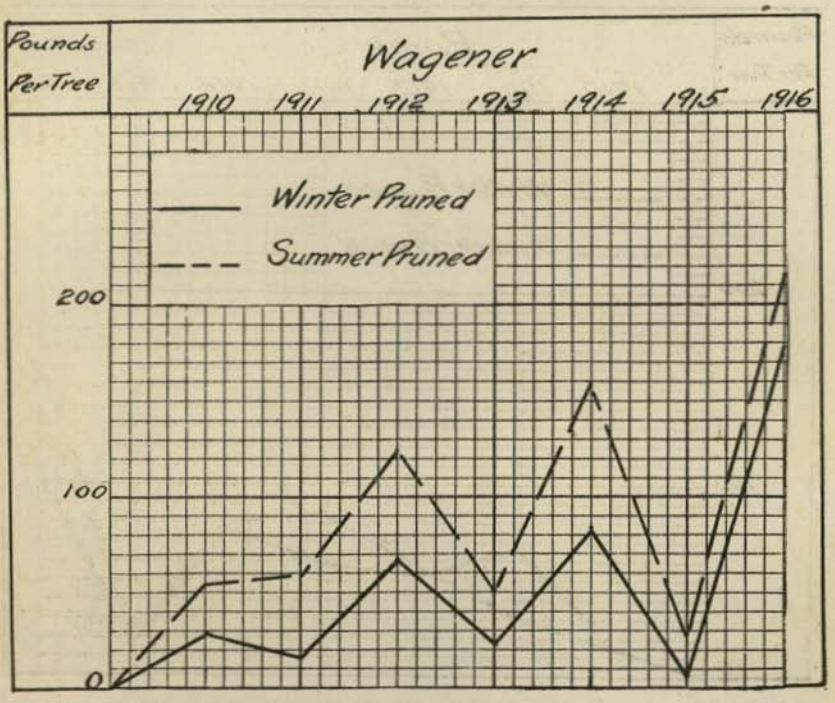

Chart 5. Showing Yearly Average Production of Wagener Trees under the two Methods of Pruning.

Bulletin No. 86 of the Dominion of Canada, says: "It is well known how important a factor sunlight is in the development of color in fruit. Fruit that is hidden by foliage is not as well colored as that exposed in full sunlight, hence the importance of thoro pruning and thinning. Heat is also an important factor in determining intensity of color. Each kind of fruit appears to have its optimum or best mean temperature in the growing season. In countries or districts with cool summer for the kind of fruit in question, the fruit is not as a rule highly colored, and where the summer temperature is very high some varieties of apples are not as well colored as where the summers are a little cooler. Fruit on young trees grows vigorously and causing the fruit to grow late is not well colored. This leads to the conclusion that the degree of maturity of the fruit has much to do with the color." Moisture in the soil also plays an important part in the coloring of the fruit.

Professor J. P. Steward, in Bulletin No. 141 of the Pennsylvania State College, states that the red colors in apples are defeloped primarily by sunlight in the later stages of maturity. Hence, conditions favoring either of these factors, such as late picking, open pruning, long growing season, sparse foliage, fully developed fruit, light soils, or sod culture will increase this color, while all opposing conditions will decrease it.

Just when during the growth of the apple is the coloring matter deposited in the skin? As shown in the following table, very little color is deposited in the skin of the apple until about the first of September, especially with such varieties as Jonathan, Rome and Wagener. Of course a dull color began to appear earlier in the season but it did not become intensified until a few weeks before the crop was harvested. The development of color on Jonathan in the summer-pruned plat in 1916 was as follows:

TABLE 13.— Showing When Color Develops on Jonathan Apples.

Date	Percentage of Surface Covered	Nature of Color
Sept. 8	20	Dull Red
Sept. 13	30	Dull Red
Sept. 18	50	Deep Red
Sept. 26	60	Bright Red
Oct. 1	90	Bright Red

In the case of the Jonathan and Rome it was found that the color was greatly intensified when summer pruning was practiced.

In discussing the subject of summer pruning at the Fruit Products Congress at the Seventh Annual National Apple Show, Mr. F. G. Carlisle said: "I believe we are losing sight of an important factor in summer pruning—by pruning at the proper

time we are enabled to get the desired color on our fruit at least two weeks earlier than would otherwise be possible. This is very important for as you all know, our Jonathan apples are arriving in the eastern markets today in an over-ripe condition, which means that the fruit matured before it colored. If we had summer pruned properly, our fruit would have had sufficient color as soon as matured, thus enabling us to pick it earlier."

The following table shows a three year average of the percentage of extra fancy, fancy, and C grade Jonathan, Rome and Wagener apples harvested from the summer and winter-pruned plats. The apples were graded according to the color requirements laid down by the North Pacific Fruit Distributors in 1914. These requirements for each variety are as follows: Jonathan, extra fancy, 75 per cent good red color; fancy, 40 per cent good red color; C grade, no color requirements. Rome and Wagener, extra fancy, 50 per cent good red color; fancy 25 per cent good red color; and C grade, no color requirements. The entire fruit crop from the Jonathan, Rome and Wagener plats for the past three years was counted and the percentage of extra fancy, fancy and C grade apples determined.

TABLE 14.— Showing Percentage of Apples in Each Grade

Variety	Winter pruned			Summer pruned		
	Per cent ex. fancy	Per cent fancy	Per cent C. grade	Per cent ex. fancy	Per cent fancy	Per cent C. grade
Jonathan	22	36	42	55	28	17
Rome	20	28	52	52	21	27
Wagener	30	32	32	41	27	32

It is evident then from the above table that summer pruning has had a very definite influence on the development of color of apples.

The actual increase in percentage of extra fancy apples when summer pruning was practiced is as follows: Jonathan, 33 per cent; Rome, 32 per cent; Wagener, 5 per cent. That no greater difference is noted in the production of extra fancy apples on the Wagener variety under the two methods of pruning is due undoubtedly to its upright growth, its scant foliage, and its fruiting habit. Summer pruning did not materially increase the amount of sunlight reaching the fruit on the Wagener trees. No detailed records were kept of the number of extra fancy, fancy and C grade apples in the summer- and winter-pruned Grimes plats. From general observations, no difference could be detected between the color of the fruit on the summer-pruned Grimes plat and those pruned in winter.

The data presented in tabulated form is also shown graphically.

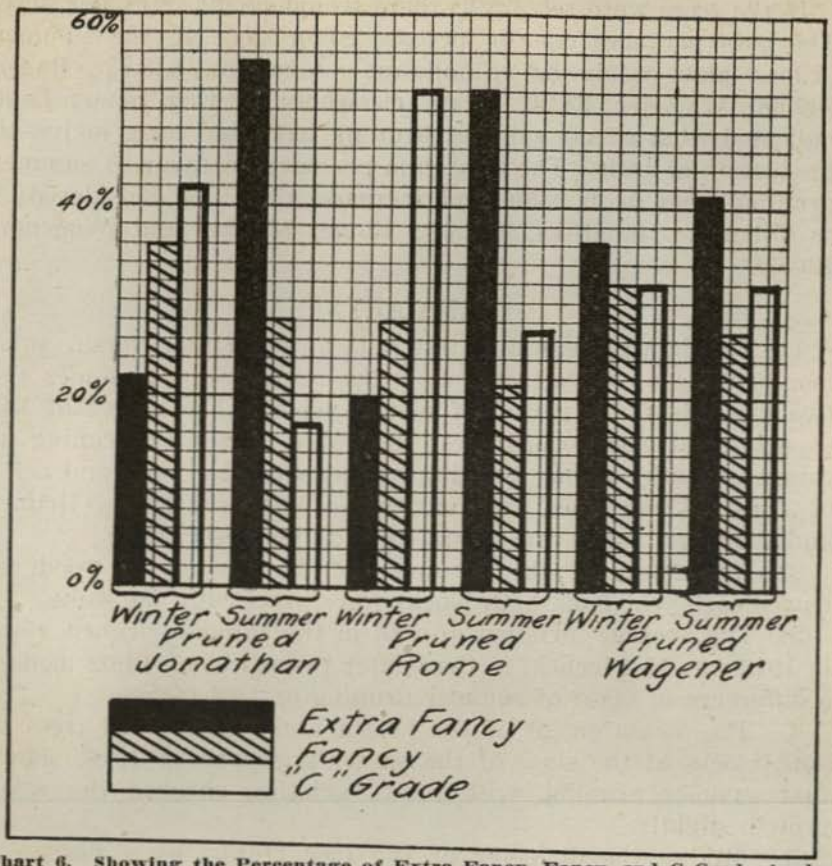

Chart 6. Showing the Percentage of Extra Fancy, Fancy, and C Grade Apples Secured under the two Methods of Pruning.

Apples must meet certain color requirements to be packed into the three grades. Assuming that a bearing tree will pack out eight boxes of marketable apples, the comparative value of the different grades under the two methods of pruning is shown in the following table.

TABLE 15.— Showing Comparative Values of Different Grades

Variety	Winter Pruned			Summer Pruned			Gain per tree summer pruning
	Extra fancy boxes @ $1.00	Fancy boxes @ $ .75	C grade boxes @ $ .50	Extra fancy boxes @ $1.00	Fancy boxes @ $ .75	C grade boxes @ $ .50	
Jonathan ...	1.76= $1.76	2.88= $2.16	3.66= $1.68	4.40= $4.40	2.24= $1.68	1.36= $ .68	$1.16
Rome	1.60= $1.60	2.24= $1.68	4.16= $2.08	4.16= $4.16	1.68= $1.26	2.16= $1.08	$1.14
Wagener ...	2.88= $2.88	2.56= $1.92	2.56= $1.28	3.28= $3.28	2.16= $1.62	2.56= $1.28	$ .10

If the trees were set 32x32 there would be 42 trees per acre. The gain per acre due to increase color alone in the summer pruned plats would be as follows: Jonathan, $48.72; Rome, $47.88; Wagener, $4.20. Data elsewhere in this report have indicated what effects summer pruning have had upon increased production of fruit. The total gain per acre, in favor of summer pruning when both color and increase yield are considered is as follows: Jonathan, $52.33; Rome, $53.64, and Wagener, $30.69.

SUMMARY.

1. The data presented in this bulletin on winter versus summer pruning of apple trees, show the results secured under the two methods for a period of eleven years. The object of the experimental work was to test the value of winter pruning as compared with summer pruning as measured by yield and color of fruit. There were four varieties—Jonathan, Rome, Grimes and Wagener, and seventy-four trees under observation.

2. The nature of the pruning and the amount of wood removed each year from both blocks were practically the same.

3. The average terminal growth in the summer pruned block in 1916 was 15.4 inches; in the winter pruned block 14.02 inches; a difference in favor of summer pruning of 1.38 inches.

4. The measurement of the height and width of all trees in both blocks at the close of the season's growth in 1916, shows that summer pruning, with most varieties, checked the wood growth slightly.

5. Taking the diameter of the tree trunks as a basis for judging vigor, we find that the trees are somewhat larger in the winter-pruned block. The difference, however, is practically insignificant.

6. With some varieties, summer pruning has hastened the bearing of young trees and increased crop production.

7. The evidence shows that thinning has a direct relation to pruning and crop production.

8. On the basis of the total production for the first seven crops, summer pruning has produced the greater yield in all varieties. The average annual increase per tree for each variety was as follows: Jonathan, 5.17 pounds; Rome, 8.37 pounds; Grimes, 7.22 pounds, and Wagner, 40.98 pounds.

9. With all red varieties of apples, under experimentation, the color was intensified as a direct result of summer pruning.

10. The crop value per acre as determined by *both* color and yield shows an average gain in the three summer-pruned plats over winter pruning as follows: Jonathan, $52.33; Rome, $53.64, and Wagener, $30.69.

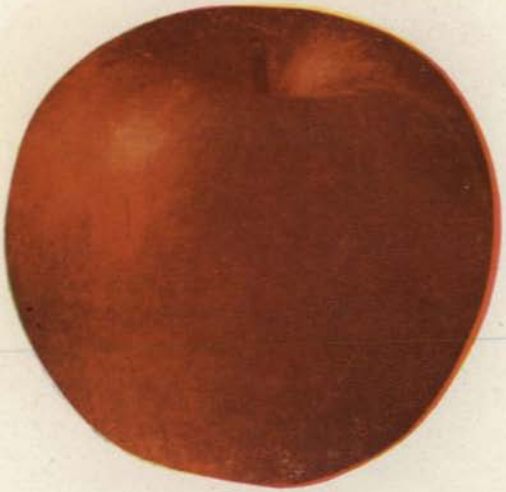

Fig. 18. Summer Pruning Favors the Development of Color in Jonathan Apples.

Fig. 19. Summer Pruning Favors the Development of Color in Rome Apples.