Enclosure with
SI
Mc-1, D-6,
5-11-'15

Pinus ponderosa

PROGRESS REPORT [1]

METHODS OF CUTTING YELLOW PINE.

By

ROBERT H. WEIDMAN

January 28, 1915

Whitman National Forest

[1] This document was transcribed from a photocopy of the original, which is located in the Supervisor's Office Silviculture Library Archives. To the greatest extent possible, this version is an exact duplicate of the original text.

SI
Mc-1 January 28, 1915.

PROGRESS REPORT

Methods of Cutting Yellow Pine.

\- - - - - -

This study was planned for the summer of 1914. The fieldwork was carried on for about two months and was then brought to a close through the lack of funds caused by the fire deficit of the 1914 season. The study, therefore, is not completed–it will be continued next season–and this report is accordingly in the nature of a progress report. Only the principal phases of the study will be considered in this report.

The main object of the study is to determine the best silvicultural method of cutting western yellow pine in District 6, particularly to ascertain the effect of that method on the reserved trees, the effect on the advance reproduction and the effect in securing reproduction. The results of the study will answer such questions as the followings:

(a) What is the behavior of the accelerated growth of reserved trees under different severities of cutting; what is its amount; how long does it continue?

(b) What is the importance of advance reproduction; how does its rate of growth after cutting compare with that of the reproduction which starts subsequent to the cutting?

(c) How soon after cutting is subsequent reproduction secured; under what severity of cutting is it best secured?

A methods of cutting study which will answer these questions may be made in two ways: by the initiation and periodic examination of permanent sample plots, which give results only after a long term of years; and by the intensive study of old cut-over areas, which gives results immediately. The present study is of the latter class.

The field work was carried on by the writer, working alone, during the months of August and September, 1914. Because of the limited time spent in the field, the work was confined to a few old cuttings in the immediate vicinity of the Whitman National Forest. The procedure followed was that set forth in the working plan for the study which was verbally approved by Mr. Zon on October 1, 1914.

<u>Manner of Conducting the Field Work</u>.

A cut-over area suitable for the study was found; i.e., one which had been cut in one operation, of which the date was know, and which was at least ten years old. On this area, sport of an acre or larger in size, were sought, which were representative of different degrees of cutting, or on which the arrangement of the remaining trees was scattered in one case and grouped in another. On such spots sample acres were laid off and all the trees upon them were measured and described, and from each tree over ten inches d.b.h. a radial core was taken with a 10-inch Mattson increment borer. The radial growth showing in these cores was analyzed by 5-year periods in the field (the basal area for the 5-year periods was computed in the office).

On these sample acres there was also conducted a careful study of reproduction. Advance reproduction was classified separately from that which started subsequent to the cutting. As nearly as it could be arrived at, the quantity of reproduction of each class was obtained, and classified by age and total height; this was done both by sample square rods – three to four to the acre – and by estimate. Also node measurements of representative advance and subsequent seedlings were made, in order to determine the relative rate of height growth of each class.

Altogether seven sample plots were taken, all one acre in size except one two-acre plot – the results from the latter were averaged and reduced to a basis of one acre for the sake of uniformity. Four of these plots were taken in the cuttings near Sumpter, and are designated Sumpter Plots I, II, III, and IV. These four plots were all in 17-year old cuttings. Plots III and IV were nearly contiguous and the other two were from one-half to two miles distant. The three remaining plots were taken near Susanville and are designated Susanville Plots I, II and III. Plots I and II were contiguous in an 11-year old cutting; Plot, III was a mile distant in a cutting approximately 45 years old.

Because of the meagerness of the fieldwork, it was not thought advisable to work up the data completely at this time. In this report only the following important points of the study will be considered.

(1) The relation of different densities and arrangements of reserved trees to the behavior of accelerated growth.

(2) The relation of the severity of cutting to the amount and development of subsequent reproduction.

(3) The rate of growth after cutting of advance reproduction as compared with that of subsequent reproduction.

No attempt will be made here to determine the differences in accelerated growth between different aged individual trees or between individuals of different crown character. Nor will windfall and brush disposal be considered at this time. In order to avoid unnecessary duplication of lengthy computations, it is planned to defer compiling the data in this connection until more extended field work shall be done.

<u>Accelerated Growth of Reserved Trees.</u>

Tables I and II, which follow, deal with the accelerated growth of the trees left standing. The tables are based on seven one-acre plots and the method of cutting practiced on each plot was logger's selection. On six of the plots the trees left standing were evenly distributed, while on one plot they were arranged in an almost intact group.

It has been found convenient in this work to refer to the trees left standing as reserved trees. This use of the term should not be confounded with its accepted use in forest management; for the cull tree left standing by the logger is obviously different from the carefully selected reserved tree of the forester. One must not be misled, however by the word cull, for a cull tree does not always mean a defective or suppressed tree. In the region where these data were collected the term cull, fifteen years ago, nearly always included thrifty bull pines up to 14 to 16 inches d.b.h. and often slightly crooked but sound trees of much larger diameter. A rough classification of the 112 trees left standing on the seven sample acres shows that 45% were thrifty and perfect bull pines, 20% were trees of larger size which were crooked or forked but otherwise sound and 35% were suppressed or defective trees.

Table I shows for each plot, in terms of basal area per one-half decade, the average growth before and after cutting; it also shows at what per cent the average growth after cutting was more rapid than that before. It will be noted that all figures for accelerated growth in this report are expressed in basal area instead of by volume. Since volume growth is closely proportional to basal area growth, it was not thought advisable to spend the extra time necessary to make volume computations. Other columns in Table I show for each plot the per cent by volume of trees left standing, the arrangement of these trees, the number per acre, their average diameter and their approximate age; also the stand per acre before cutting and the volume of the trees left standing at time of cutting.

Table II gives for each plot the average basal area growth per one-half decade for a stated period of years before cutting (50-60 years) and for the whole of the period since cutting.

Tentative conclusions follow the tables.

It would be best, perhaps, for a clear understanding of the tables, to consider at this point the general subject of accelerated growth. First, in this connection a brief explanation should be made of the column in Table I which is headed: “Accelerated Growth – Per cent Faster after Cutting than before”. The figures in this column were derived by the following simple operation, as illustrated by the figures for Sumpter Plot I:

$$\frac{.082 - .020}{.020} = 310\%$$

This gives correctly the per cent by which the average basal area growth after cutting (the accelerated growth) was more rapid than the average basal area growth before cutting.

It should be noted distinctly that the 310 per cent above does not concern itself with the increase in basal area growth due to the stimulating effect of the cutting. It should further be noted that this report contains no figures of growth due to stimulation; but it does contain figures representing the rate of accelerated growth. What then is accelerated growth after cutting? As here used, it is that growth which is equal to the sum of the growth that would have taken place if no cutting had been made plus the growth due to the stimulating effect of the cutting.

In order to determine the stimulated growth it is necessary to know the growth that would have been made under uncut conditions for the period since cutting. But the latter it is impossible to get by any absolute method, and the writer knows of no satisfactory arbitrary method of arriving at it. Arbitrary methods involve the relation of the width of annual rings to the increasing diameter of the tree. Thus there are four possibilities:

(1) A decreasing width of successive annual rings, greater than a certain ratio, results in a decreasing basal area growth.

(2) A decreasing width of successive annual rings, less than a certain ration, results in a sustained basal area growth.

(3) An equal width of successive annual rings results in a slightly increasing basal area growth.

(4) An increasing width of successive annual rings results in a pronouncedly increasing basal area growth.

For any assumed condition in the change of ring in the above possibilities, the percent of increase in basal area can be mathematically determined for different diameters. The result of this computation then gives the percent of increase corresponding to that which would have taken place under uncut conditions. And the difference between this per cent and the per cent of actual increase, appearing in the increment core, gives the per cent of increase due to stimulation. The writer has observed one instance in a report in which the third possibility given above was used in this way. As stated some pages back, however, figures showing stimulated growth are not presented in this report. There has been no special need for presenting them. The subject has been mentioned at this length in order to prevent any misunderstanding in connection with the tables and the conclusions.

TABLE I – ACCELERATED GROWTH

No. Plot	Method Of cutting	Per cent Left by Vol.	Average Basal Area Growth per one-half decade, in Square Ft.		Accelerated Growth per cent faster after Cutting than before	Description					
						Stand per Acre Before Cutting In board feet.	Volume of trees left at time of cutting Bd. Ft.	Trees left over 12”			Site
			Before Cutting	After Cutting				No. per Acre	Diam. Av.	Age Approx.	
Sumpter I	Even distribution	9	* .020	** .082	310	23,145	2,105	11	17	250	II
Sumpter IV	“	10	* .037	** .118	219	28,025	2,800	13	18	250	I
Sumpter II	“	12	* .040	** .137	242	34,505	3,990	17	19	250	I
Susanville II	“	20	+ .034	++ .082	141	20,130	4,135	13	18	240	I
Susanville I	“	32	+ .044	++.089	102	23,245	7,515	19	19	245	I
Sumpter III	Group (Big intact)	22	* .046	** .075	63	21,260	4,585	18 (Including 3 Larches)	19	190	I
			(Per whole	decades)							
Susanville III	Even distribution	32	*.125	// .241	#48	30,060	9,785	7	31	340	I

* For a period of 60 years before cutting.
+ For a period of 50 years before cutting
** For a period of 15 years following cutting
++ For a period of 10 years following cutting
// For a period of 40 years following cutting
48 per cent here is the average for the 40 years since cutting:
The percent faster by separate decades is as follows:

1st. decade after cutting 141
2nd. decade after cutting 108
3rd. decade after cutting 105
4the decade after cutting 17

TABLE II

Average Basal Area Growth in Square Feet per ½ Decade beginning 75 years. (60 and 100) Ago.

Sumpter Valley Cut-over Areas – 17 yrs. since cutting.

Years	75-70	70-65	65-60	60-55	55-50	50-45	45-40	40-35	35-30	30-25	25-20	25-15	15-10	10-5	5-0	No. of trees Averaged
Plot I	.019	.018	.018	.017	.021	.022	.019	.022	.025	.023	.019	.021	.054	.094	.099	23
Plot II	.028	.025	.029	.033	.042	.047	.040	.052	.045	.042	.039	.054	.123	.133	.156	17
Plot III (Group)	.033	.040	.042	.045	.054	.051	.047	.056	.045	.053	.040	.042	.060	.076	.089	18
Plot IV	.028	.030	.030	.036	.039	.046	.040	.042	.042	.042	.034	.039	.082	.127	.146	13

Susanville Cut-over Areas – 11 yrs. since cutting

Years	60-55	55-50	50-45	45-40	40-35	35-30	30-25	25-20	20-15	15-10	10-5	5-0	Number of trees Averaged
Plot I	.039	.046	.038	.037	.056	.044	.042	.045	.043	.046	.078	.099	21
Plot II	.037	.044	.031	.028	.035	.033	.032	.030	.031	.036	.069	.094	13

Susanville Cut-over Areas – 45 yrs. since cutting (by decades)

100-90	90-80	80-70	70-60	60-50	50-40	40-30	30-20	20-10	10-0	Number Trees Averaged
.148	.143	.099	.083	.125	.151	.301	.260	.257	.146	7

Conclusions – Tables I and II

(1) Accelerated growth is much less pronounced in the intact group arrangement of reserved trees than in even distribution. On five of the plots on which even distribution was the arrangement, the average accelerated growth after cutting was 203 per cent faster than before cutting, while on the one plot, on which the reserved trees were in the form of an intact group, it was only 63 per cent faster. Comparing a plot (Sumpter IV) with even distribution, which lay almost contiguous with the group plot, the figures are 219 per cent and 36 per cent respectively.

(2) In even distribution the rate of accelerated growth varies inversely with the per cent by volume of trees left standing. This is shown by the following figures from the table:

Per cent of trees left by volume	Accelerated growth per cent faster after cutting
10	257 (average for 3 plots)
20	141
32	102

(3) Accelerated growth does not continue at the same rate. But for all of the plots except one, the period since cutting is too short to afford data for determining how it continues. In the case of six of the plots the period since cutting is 11 years and 17 years; in the case of the seventh plot it is approximately 45 years. Table II shows that in the 11 and 17 year old cuttings the average rate of accelerated growth increased gradually during this period of years; but that in the one instance of the 45 year old cutting the rate of acceleration consistently decreased-gradually in the first three decades and very abruptly in the fourth decade after cutting. One plot does not furnish a sufficient basis for conclusions as to the behavior of accelerated growth for a long period of years. Further study on a number of old cuttings, however, will determine this definitely. In the case of the one plot studied, possible explanations of the decrease in the rate of acceleration are the following: the gradual decrease may be due to the old age of the trees, 340 years; and the very pronounced decrease in the fourth decade after cutting may be due to the strenuous root competition of the dense sapling reproduction which has crowded up to the bases of the old trees. This reproduction is five feet to thirty feet tall, about 40 years old and very vigorous.

Quantity of Reproduction

Table III concerns itself mainly with the quantity of reproduction per acre. It shows for each plot the total amount of reproduction, the separate amounts of advance and subsequent reproduction, the age of each class and the period of years since cutting. For the subsequent is also shown the per cent of seedlings which are two years old and under. It is interesting to note in the case of the subsequent reproduction that on the Sumpter plots there are two widely separated age classes, one two years old and under and the other exactly 17 years old; the yearlings make up only one to four per cent of the total subsequent reproduction. In the case of Susanville Plot I all ages up to ten years (the period since cutting) are represented, but here the seedlings two years old and under make up 74 per cent of all the subsequent reproduction. This seems to indicate that except for unusually favorable conditions the mortality of one and a two year seedlings is very high.

Susanville Plots II and III have not been worked up as completely as the other plots because of insufficient field records. Plot II was taken contiguous with Plot I, however, and the reproduction was very similar on both plots.

Species other than yellow pine are not included in the table; the highest per cent on any one plot was 3%.

TABLE III-QUANTITY OF REPRODUCTION

Plot No.	Per cent Trees Reserved by Volume	Quality Reproduction per Acre	Advance		Subsequent			Period since Cutting in years
			No. per Acre	Age in Years	No. per Acre	Per cent 2 yrs. old and under	Age of that over 2 Yrs.	
Sumpter I	9	10,898	2	20-28	10,896	3	17	17
Sumpter IV	10	2,562	-	-	2,562	1	17	17
Sumpter II	12	13,560	200	20-28	13,360	1	17	17
Susanville II	20	6,940	(mostly Advance similar to Susanville Plot I)	13-21	-	-	3-10	11
Susanville I	32	14,302	8,745	13-21	5,557	74	3-10	11
Sumpter III (Group)	22	8,113	3,455	30-38	4,658	4	17	17
Susanville III	32	3000 to 6000	-	-	(Probably all Subsequent)	-	45	45

Conclusions – Table III.

The data are insufficient to afford a basis for definite conclusions; they are complete enough, however, to indicate the followings:

(1) When the reserved trees are evenly distributed and make up 9% to 32% of the original stand, and other conditions are favorable, there is established a very dense cover of subsequent reproduction, from 2,542 to 13,360 seedlings per acre.

(2) That the quantity of subsequent reproduction increases with the severity of cutting, it is not safe to conclude because of the meagerness of the data.

(3) On the tree plots on which advance reproduction occurred heavily, the original stand had been groupwise; on three of the plots on which advance reproduction was absent or negligible in quantity, the original stand had been more evenly distributed.

Height Growth of Reproduction

Table IV and figures 1 and 2 deal with the height growth of reproduction. The table compares by plots the advance with the subsequent reproduction in regard to average total height, age and number per acre. Figure 1 compares the height curves of the dominant advance and subsequent reproduction found on Sumpter Plot II. Figure 2 represents the height curve of the dominant advance reproduction on Susanville Plot I. It should be noticed that these curves are not based on age but on the number of years after and before cutting; this explains the unusual points of origin of the curves.

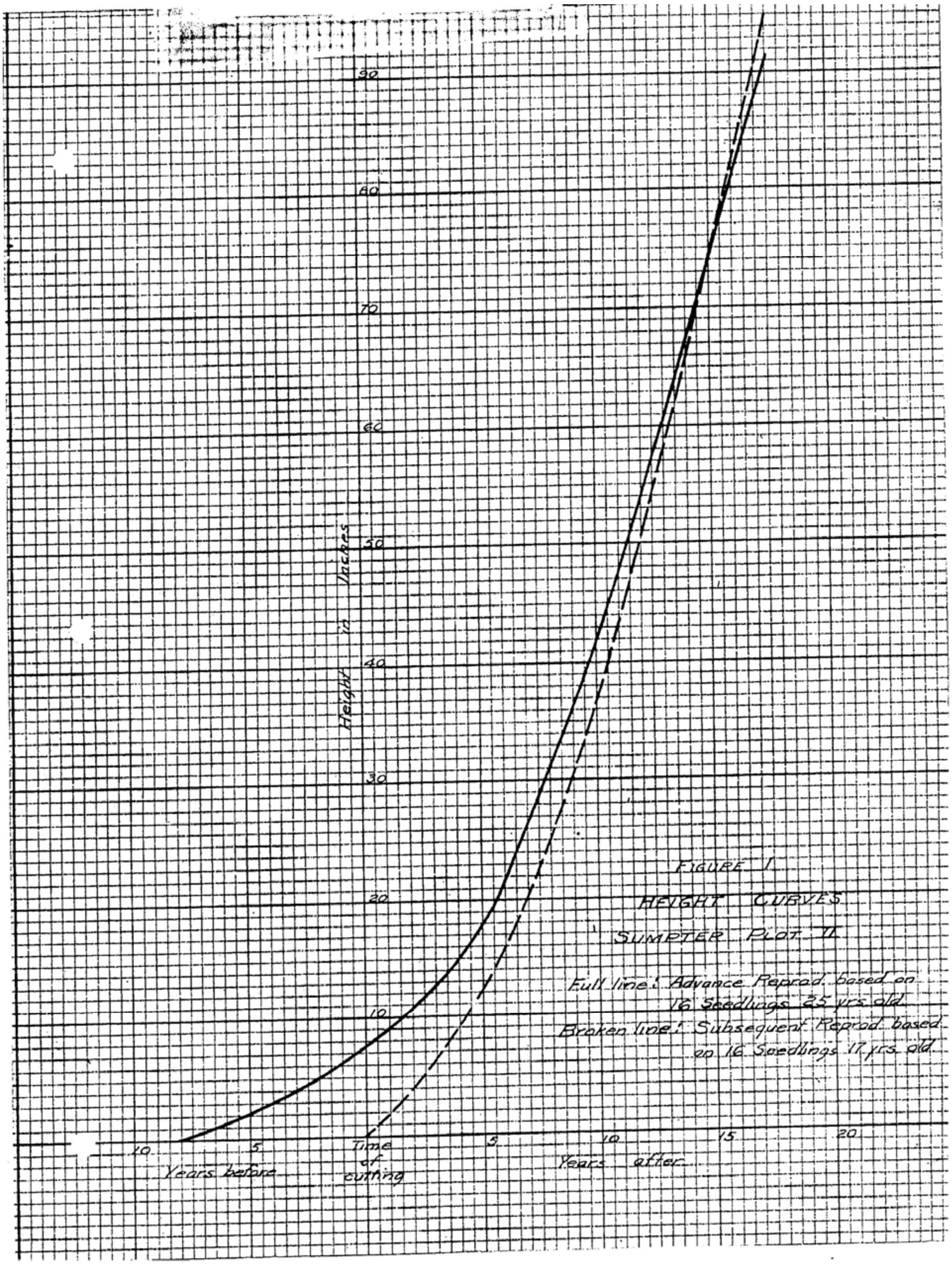
FIGURE I
HEIGHT CURVES
SUMPTER PLOT II
Full line: Advance Reprod. based on 16 Seedlings 25 yrs old
Broken line: Subsequent Reprod. based on 16 Seedlings 17 yrs old
Height in Inches
Years before
Time of cutting
Years after

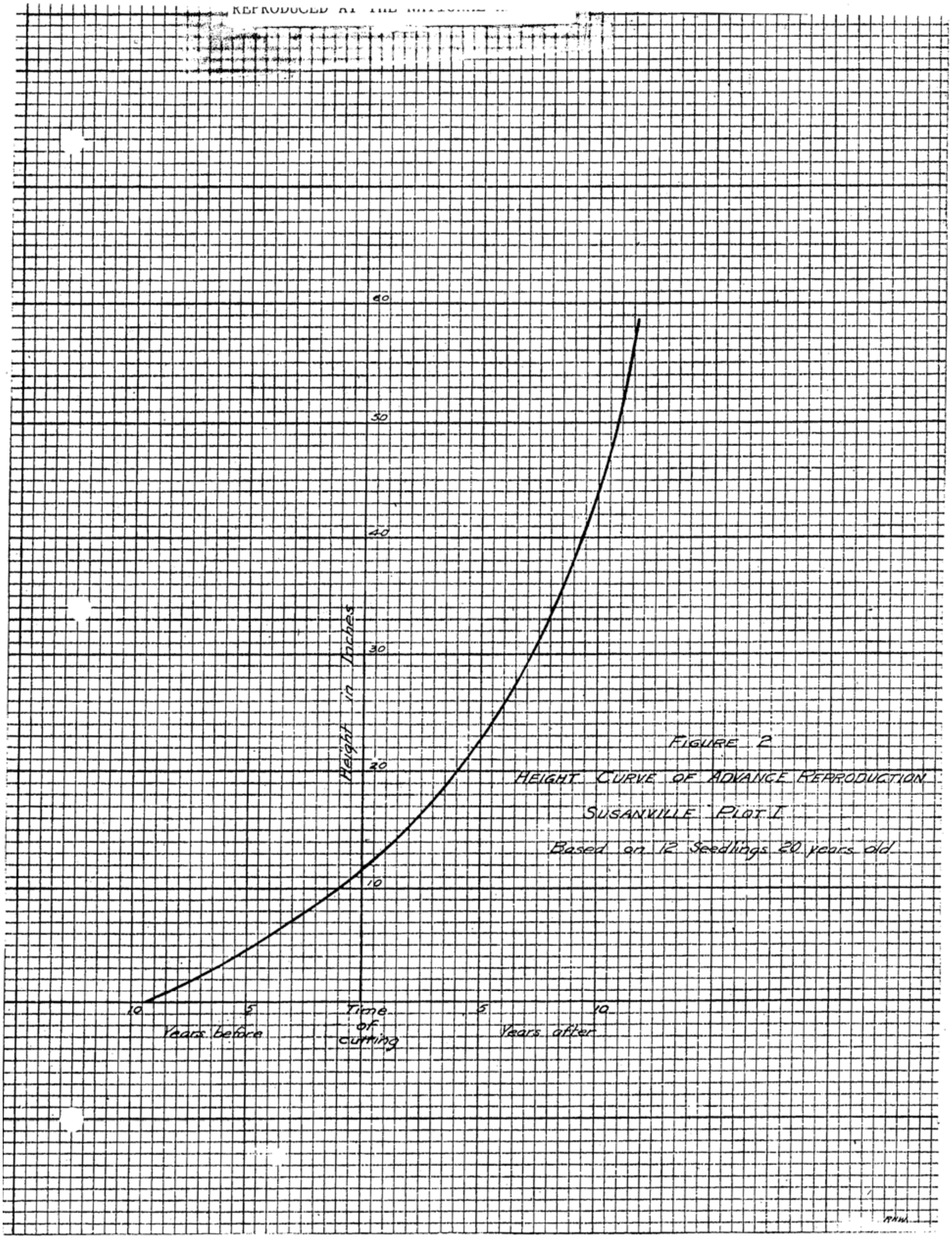

FIGURE 2
HEIGHT CURVE OF ADVANCE REPRODUCTION
SUSANVILLE PLOT I
Based on 12 Seedlings 20 years old

TABLE IV – HEIGHT OF REPRODUCTION

Plot No.	Subsequent Reproduction			Advance Reprod.			Remarks.
	Av. Height Feet & tenths	No. per Acre over 2 Yrs. old	Age	Av. Height Feet & Tenths	No. per Acre	Age	
Sumpter I	4.2 *1'-12'	10,571	17	-	2	-	This plot is Site II; all the rest are Site I.
Sumpter IV	6.7 1'-12'	2,542	17	-	-		This subsequent reprod. is very vigorous making good diam. growth as well as good height growth. Probably due to less density of stand of reprod.
Sumpter II	5.0 1'-10'	13,246	17	5.0	200	20-28	Adv. reprod. here accelerated vigorously; but subsequent reprod. has just caught up with it. See curves Fig. 1.
Susanville I	1.1	1,444	3-11	2.2	8,745	13-21	Adv. reprod. here accelerated moderately. Subsequent reprod. has not been able to establish a cover. See curve for advance.
Sumpter III	3.4 1'-12'	4,454	17	3.7	3,455	30-38	Reserved trees in group. Adv. reprod. on this plot did not accelerate; it has stagnated—perhaps too old to recover—154 on sample sq. rod.

*These figures indicate range in height of subsequent reproduction found on each plot.

Conclusions – Table IV and Figures 1 and 2.

(1) With regard to advance reproduction the data gathered show conclusively that height growth is stimulated by the cutting; also they show strikingly that the effect of stimulation is far from uniform. The data available indicate that the difference in effect is not due so much to the degree of cutting as to the density of the advance reproduction and its age at the time of cutting.

(a) On Sumpter Plot II the height growth of the advance reproduction increased vigorously after cutting, taking place three times as fast for a period of eight years following cutting as for the same period before. On this plot the advance was scant and scattered (about 200 seedlings per acre) and its age at time of cutting was five to eleven years.

(b) On Susanville Plot I the height growth of advance after cutting increased only moderately, its rate for tine years after cutting being twice as rapid as for the same period before. Here the advance reproduction was very dense in patches, and its age at the time of cutting was three to ten years. Figures 1 and 2 show height curves for this and the preceding.

(c) On Sumpter Plot III, height growth after cutting underwent practically no increase whatever. Here the advance reproduction occurred dense in patches, and its age at the time of cutting was 13 to 21 years – considerably older than the preceding.

(2) That the rate of height growth of subsequent reproduction is more rapid than that of stimulated advance reproduction is indicated by the following:

(a) On Sumpter Plot II, where the advance accelerated most vigorously and where it had a start of seven inches in height (average), the subsequent caught up with and passed it in 15 years. This is excellently shown by the curves in figure 1.

(b) On Susanville Plot I, where the advance accelerated only moderately, its average total height now (11 years after cutting) is 2.2 feet and that of the subsequent is 1.1 feet.

(c) On Sumpter Plot III, where the advance did not accelerate at all, its average total height now (17 years after cutting) is 3.7 feet and that of the subsequent is 3.4 feet. Here is an excellent example of stagnated advance reproduction. It occurs in large dense patches composed of sickly and spindly stemmed individuals whose height growth for the last 17 years has rarely exceeded one inch a year. The main reason for its inability to respond to the stimulating influence of cutting was probably its age—13 to 21 years—at the time of cutting, and its density. The dominant subsequent reproduction has long ago outstripped this stagnant advance on this plot; for although the average height of the subsequent is only 3.4 feet, the dominant seedlings range from three to twelve feet tall.

While the foregoing three comparisons of advance with subsequent reproduction show that the rate of height growth of the latter is more rapid than the accelerated growth of the former, it is not safe to say that this holds in all cases. For instance, it would not be safe to say that the subsequent reproduction on Sumpter Plot II would have caught up with the open vigorous advance if the latter had been 30 years old instead of 10 and had had a start of 36 inches instead of 7 inches.

(3) That the height growth of subsequent reproduction becomes less with the increase of the per cent of reserved trees cannot be concluded because of the meagerness of the data.

(4) That the height growth of the subsequent reproduction is more rapid when the quantity per acre is moderate, is indicated by Sumpter Plot IV. Here 2,542 seedlings per acre have an average total height of 6.7 feet, whereas on Plots I and II which have an average of 11,908 seedlings per acre, the average total height is 4.6 feet, the age being the same for all three plots. The data indicate this only for a reserved stand of 9% to 12%.

Recommendations for Field Work Next Season

To collect comprehensive data necessary to attain the object of this study will require at least two more months in the field for two men.

As far as conditions will permit, the study should be conducted in cuttings considerably older than 10 years. Special endeavor should be made to find at least two or three cuttings between 30 and 50 years old, in order to discover the later behavior of accelerated growth – to learn whether acceleration consistently falls off as it did in the case of the only real old cutting studied last summer.

A great variety, in per cent by volume, of trees left standing should be studied, ranging from 10 to 35 per cent.

More data should be collected in evenly distributed reserved trees than in groups, but a representative number of intact groups should be carefully studied.

Clear cut areas also should be studied next summer, with reference to source, amount and condition of reproduction.

In order to determine the relative rate of height growth of subsequent reproduction, node measurements should be taken on at least 15 representative dominant seedlings on each acre plot studied. This number of seedlings gives data for a fairly accurate height curve. Where advance reproduction occurs, node measurements should also be taken of a representative number so as to compare the two classes of reproduction and determine the ultimate value of advance reproduction.

Study should also be made of fire-swept cuttings to ascertain the status of reproduction on such areas.

The condition and disposal of brush on cuttings should be studied with regard to fire and reproduction.

Particular attention should be given to the windfall history of each area studied.

Robert H. Weitknecht