WESTERN WHITE PINE

ITS RELATION TO FOREST MANAGEMENT.

-o-

Senior Seminar.
Oregon Agricultural College.
School of Forestry.

June 1928

By
Ezra M. Hornibrook.

Accepted
May 31, 1928.
Fred V. Pearce

WESTERN WHITE PINE-

ITS RELATION TO FOREST MANAGEMENT.

INDEX

INDEX (CONTINUED)

WESTERN WHITE PINE-
ITS RELATION TO FOREST MANAGEMENT.

INTRODUCTION.

ECONOMIC IMPORTANCE:

Western white pine (Pinus monticola D. Don) is one of the most valuable soft woods in the United States. It does not form pure stands, nor does it reach such large size as many other western conifers. It is, nevertheless, an important tree because it produces wood of excellent quality which is little inferior to that of Northern white pine and it invariably grows with other important timber trees in forests of high economic value. The rapid growth of western white pine, its excellent wood, high yield, and adaptability to forest management establishes its importance as a forest tree in the Pacific northwest.

PRESENT STAND:

The United States Department of Agriculture Statistical Bulletin No. 21 for 1925, gives western white pine a stand of 1,700,000 acres, a total stand of 18,586,000,000 board feet, with an annual increment of 136,000,000 board feet. The approximate annual cut is slightly over one billion board feet.

BOTANICAL AND COMMERCIAL RANGE:

Western white pine is found from Vancouver Island and

southern British Columbia (coast and gold ranges) through northern Idaho (Coeur d' Alene and Bitter Root Mountains) to northern Montana (Flathead River) and southward through Washington and Oregon (Cascade Mountains) to California (on Sierra Nevada to Tulare County between the Big and Little Kern Rivers). The commercial range of western white pine is generally considered in the Inland Empire, or northeastern Washington, northern Idaho and western Montana. It is in its commercial range that white pine will be dealt with in this treatise. White pine is found growing from near sea level in western Washington to 11,000 feet in southern California, but it is seldom found in commercial sizes or quantities at elevations over 4,000 feet.

SILVICULTURAL CHARACTERISTICS

FORM OF STAND

White pine seldom if ever is found in pure stands, but associates with western larch, western red cedar, western hemlock, Engelmann spruce, Douglas fir, lowland white fir, alpine fir, amabilis fir, cottonwood and white birch. The main forest types as classified by United States Forest Service, District 1, are:

White Pine Type, which is found along the stream bottoms and bottom of slopes where white pine comprises 15 to 80 per cent of the stand.

Larch-Douglas fir Type, which occupies the poorer sites at medium elevation with a limited mixture of white pine in the stand. Cedar-Hemlock Type, occurs at medium to high elevations. This is a climax forest, with only very scattered white pines.

GROWTH:

Western white pine in its optimum range produces a long, cylindrical bole, clear one half of its length, with slight taper and with a spreading and fairly deep root system. It attains an average size of 135 to 160 feet in height and a diameter of 20 to 30 inches. Larger sizes have been recorded.

White pine is generally considered slow growing in youth, It has a very rapid increase in height from the tenth to the fortieth year, and with a rapid diameter growth up to 90 years after which it slows off to decadence which sets in from 200 to 300 years.

HABITAT:

Western white pine is not exacting in its requirements but prefers cool, moist slopes and river valleys. In Idaho it does best in moist stream bottoms and gentle north slopes.

CLIMATIC REQUIREMENTS:

White pine endures a wide range of climatic conditions, as it withstands a range in temperature of 30° F. to 100° F. Rainfall within its range varies from 80 inches in the Puget Sound region in Washington to 15 inches in parts of Montana

and Idaho.

SOIL AND MOISTURE REQUIREMENTS:

Western white pine will grow on a great variety of soils, its chief requirement being a sufficient supply of soil moisture. It does best in deep, well drained, porous solis, though it grows abundantly on poor sandy situations and is frequently found growing on shallow and rocky soils.

LIGHT REQUIREMENTS:

In its light requirements western white pine is somewhat intolerant, more so than western larch, Douglas fir, lodge-pole pine and sugar pine, and is less intolerant than western hemlock, western cedar or spruce. It is more tolerant in youth than in old age and its power to recover from suppression is lost early in life.

REPRODUCTION;

As a seed producer western white pine is not very prolific. Some seed is produced every year, especially abundant seed producing years occuring every 4 to 6 years. The seed is of fair size, is well winged and is widely scattered by the wind. Fresh mineral soil makes the best seed bed. The seedlings require broken shade the first year.

In a report upon an investigation of the seed production of western white pine on the Kaniksu and Couer d' Alene National Forests in Idaho and published in the United States Department

of Agriculture. Bulletin No. 210 in 1915, Raphael Zon states, "An idea of the reproductive capacity of a single tree may be gained from the record of the largest yield by an individual white pine tree, which was 2½ ounces, or 6,000 germinable seed.

"If from individual trees we turn to stands, we find that normally stocked stands bear from 2½ to 5 pounds of germinable seed per acre, or, assuming an average of 30,000 seed to the pound, from 75,000 to 150,000 germinable seed. The average of three pounds, or 90,000 germinable seed, per acre for a moderately good seed year may therefore be accepted as the average seed crop.

"Crown development and age of the trees evidently has an effect upon the amount and quality of seed produced. The younger trees ranging from 72 to a little over 100 years in age, have produced practically in all three crown classes a larger quantity of germinable seed than the older trees. Apparently the age has also something to do with the average length of the cones, since the younger trees possessed, on an average, longer cones which yielded a larger number of pure seeds per cone than the older trees. The germination percentage was also greater in the younger trees than in the old ones; ninety per cent, the highest germination, was found in a tree 72 years old, while the highest found in the older trees was 67.5 per cent. There seems to be a tendency for the larger

seeds to have the highest germinative vigor. The percentage of germination decreases with the increase in the number of seed per pound--with the decrease in size of the seed. The larger or heavier the cones the larger is the seed, and the larger the seed the greater is the germination percentage. Therefore, the larger the cones, the better is the quality of the seed."

FOREST MANAGEMENT

OBJECTS OF FOREST MANAGEMENT

The objects of forest management are:

1. To dispose of the present crop and to bring about a normal distribution of age classes so as to establish the forest on a sustained yield basis.
2. To increase the percentage of white pine and other valuable species on areas suitable for their development.
3. To collect all data possible for further developing and managing the stand.

FOREST TYPES

The following forest types are as classified in the forest management plans for the Forest Service, District One.

The White Pine Type of stand is made up of western red cedar, western hamlock, white fir, western larch, Douglas fir, and Engelmann spruce. White pine constitutes 15 to 80 per cent of the stand. Western red cedar is equally valuable

with the white pine when cut in pole sizes, the cedar usually occuring as an understory, tends to prune the pine at an early stage. This type of stand is limited to the stream and river bottoms and low gentle slopes.

The Larch-Douglas fir Type, which has but a small percentage of its volume made up of white pine, is on the poorer sites and at medium elevation and of secondary value.

The Cedar-Hemlock Type is found from medium to high elevations, is a climax forest and has only very few, scattered, white pines.

SILVICULTURAL SYSTEM (method of cutting)

In general there are two systems of cutting practiced in the white pine region. In some localities under the present economic conditions, only the larger and most valuable products can be removed from the stand. This results in a selective system of cutting the white pine and red cedar poles, leaving small, unmerchantable trees and undesirable species in the stand until the next rotation. In other places a combination of clear cutting in strips and clear cutting leaving seed trees is practiced. This practice is employed in the White Pine Type where the narrow stream bottoms and gentle slopes are cut clear of the white pine and western red cedar which comprises the major volume of the stand. This system leaves

clear cut strips along the streams and the bottoms of the slopes.

For the management of the white pine stands of the Kaniksu and Couer d' Alene National Forests of Idaho the Forest Service advocates a rotation of 120 years and a cutting cycle of 60 years. This differs considerably from the practice of using a 40 to 60 year rotation in the white pine stands of the New England states. In the future it may be found that a much shorter rotation may be used profitably for the growing of special products.

LOGGING PRACTICE

The logging practice as outlined in the forest management plans for the white pine stands in the Kaniksu and Couer d'-Alene National Forests in Idaho may be considered as standard for the white pine region. Steam logging, or the use of high lead or ground-line skidding is not allowed; rail road logging is encouraged if oil or gas is used as fuel. The ban on power logging is imposed because of the increased fire risk and the great amount of damage to the reproduction and the residual stand after cutting the merchantable trees.

Horse logging and hauling to the railroad and to driveable streams is encouraged where ever it is possible.

BRUSH DISPOSAL

Several types of brush disposal have been used in the white pine region. Broadcast burning has not been satisfactory because of the damage to reproduction and to the reserve stand. Lopping and scattering has been used extensively in places but this practice has been discontinued because of the increased fire hazard. The present policy followed by the Forest Service in the white pine stands in Idaho is to pile and burn on all areas possible. In a few cases broadcast burning is employed to remove fallen, decadent and diseased trees if favorable conditions are found.

In an article, "Slash Disposal In Pine Forests of Idaho," published in the West Coast Lumberman, Oct. 15, 1924, J. A. Larsen, Forest Examiner for the Priest River Forest Experiment Station, states, "The cost of slash disposal to the government on Forest Service sales equals 30 per cent of the stumpage value of the timber sold."

The method of slash disposal giving the best results must leave seed trees, reserve trees and most of the duff and reduce the fire hazard to the safety point. An expenditure up to one dollar per thousand board feet is justifiable for the reduction of the fire hazard alone.

Piling and burning is the best method of slash disposal as it saves 70 per cent of the duff, saves the forest cover,

conserves soil moisture, protects site factors, and its advantages outweigh the extra cost of operation.

REPRODUCTION METHODS

Cutting and silvicultural practices that will promote natural regeneration are desirable. Natural regeneration is readily attained after removal of the mature stand because of the seed stored in the duff, the abundant seed production of white pine, and the great distance of wind dissemination. Planting should be resorted to only where natural regeneration has failed. It is the Forest Service policy in the National Forests of Idaho to leave 10 per cent of the cruised volume of the stand for seed trees.

When natural regeneration has failed or when it is not desirable to wait for natural reproduction to come in, artificial reproduction by broadcast seeding, seed spot method or by planting of nursery grown seedling may be resorted to.

The broadcast method is not in favor because of the great waste of seed. Some of it is destroyed by birds and rodents and much of it falls on spots unsuitable for seed germination.

The prepared seed spot method may be used but it is unsatisfactory because of the expense entailed in the preparation of the seed spots. Then, too, rodents hunt out the seed spots and destroy a high percentage of the seeds.

Artificial regeneration by the planting of nursery grown

stock is the most sure method of getting reproduction after cutting. Reproduction by planting has the advantage of securing a fully stocked stand with the desired species combined with no loss of time by having to wait for reproduction to come in naturally.

Numerous experiments have been carried on throughout the white pine region in the growing of white pine seedlings in the nursery, and in the field planting of the stock. White pine adapts itself readily to nursery practice and the survival of the transplanted seedlings combined with the advantages of a fully stocked stand justifies the extra cost of this system of gaining reproduction.

G. W. Wahlenberg, Assistant Silviculturist for the Northern Rocky Mountain Experiment Station, in an article published in the Journal of Agriculture Reasearch for Oct. 1, 1926, states, "Success in planting in the region as a whole is very largely dependent upon adequate rainfall, especially the first year or two after planting.

"In general the survival of planted western white pine trees places 2-2 transplant stock at the top, with 1-2, 2-1, 2-0, and 1-1 following in descending order. Height growth also conforms to this order. The cost of survival definitely favors 2-0 seedlings on moderate sites, and 2-2 or 1-2 only on the more severe sites.

"Aspect of planting site is as important as the class of stock. Of the four exposures tested, the lowest survival, accompanied by the fastest growth, occured on the west exposure. The east, northeast, and northwest aspects showed considerable survival in the order given."

The average cost of planting 2-2 white pine stock on the planting areas near Wallace, Idaho was 13 dollars per thousand. This included the cost from the gathering and extracting the seed to the transplanting in the field. This work was done during the war when prices were abnormally high. It may be safe to assume that with present economic conditions white pine seedlings could be grown and transplanted in the field at a somewhat smaller cost.

GRAZING

Grazing in some forest regions of the Northwest returns considerable revenue to the owners. The extent to which forests under management can be grazed without damage to the forest growth has received much attention.

H. J. Ninman in an article dealing with the effect of pasturage on white pine reproduction and on timber quality, published in the Journal of Forestry for May, 1927 says, "The present practice of over-pasturing the wood lots is highly detrimental to the timber, and that neither a good grade of timber nor a high yield can be expected where

excessive over grazing is practiced."

Hugh Sproat in his article, "Do Sheep Eat Pines?," printed in the National Wool Grower, June 1926, says, "In all my twenty-five years of experience in the forest I have yet to see a pine or fir seedling hurt by sheep. In fact, there is very serious complaint in some sections, particularly eastern Oregon, that the tremendous increase of coniferous trees has seriously injured the grazing."

Also he says, "The grazing of our forests has not only not been a detriment, but an actual advantage to forest growth and perhaps an advantage everywhere."

Under forest management it will be necessary for the owner to determine whether the forest is to be grazed and the extent to which grazing will be permitted. This will depend upon the type of stand, density of stand, age of stand, condition of the forest floor, and the forage present on the area.

PROTECTION

INSECTS

The mountain pine beetle, Dendroctonus monticolae, is the only species whose ravages have caused any noticeable damages, and these infestations rarely cover any extensive area. The removal and utilization of infected trees is desirable, both as a protective measure and as a means of saving the diseased timber. This should be done wherever the stand is accessible.

FIRE

Fire causes enormous damage in the white pine stands. Due to the thin bark of the white pine it is easily fire killed. Fires burn rapidly in the stands because of the resinous nature of the litter on the ground and the dry conditions and long periods of low humidity which prevail during the summer months in the white pine region.

Fire, in the past 13 years (1914 to 1926), has burned on government land 83,746 acres. Of this an area of 74,032 was burned in the bad fire year of 1926.

The causes of fire, as determined in the Kaniksu and Coeur d' Alene National Forests in Idaho are as follows:

Cause of fire.	Per cent of fires.
1. Lightning	65
2. Brush burning	8
3. Campers	9
4. Incendiary	4
5. Lumbering	3
6. Miscellaneous	6
7. Unknown	5
Total	100

An efficient fire protection organization is a most desirable feature in the management and protection of a white pine stand.

FUNGI

James R. Weir and Ernest E. Hubert in the United States Department of Agriculture Bulletin No. 799, 1919, "A Study of the Rots of Western White Pine," state, "The three main wood-destroying fungi in the order of their importance are Trametes pini, Polyporus schweinitzii, and Fomes annosus. Most of the rot found in the tree is traceable to Trametes pini.

"Trametes pini attacks all portions of the trunk, acting in some cases as a typical butt-rot. Polyporus schweinitzii is found to produce a typical butt-rot, and Fomes annosus is chiefly confined to the roots and butt of the tree."

The white pine blister rust is a menace to the white pine timber industry. As yet it has not found its way into the commercial stands of eastern Washington and Idaho but eventually it will be a serious drawback to the growing of white pine timber. But even so, the value of white pine timber will surely pay for the added expense of fighting the disease and in keeping the stands free of its host, the wild and cultivated currants and gooseberries.

J. F. Martin, Pathologist, in the United States Department of Agriculture, Misc. Circular No. 40, July 1925, says, "The cost of eradicating wild currants and gooseberries will vary according to the difficulties encountered doing the work, such as the density of underbrush, number of bushes per acre, and the character of the ground. In the eastern United States

eradication of currants and gooseberries has averaged 25 cents per acre on 3,450,000 acres, while on an experimental area of 8,000 acres in northern Idaho it averages $1.63 per acre. Compared with the value of the white pines protected the cost of applying control measures is reasonable and profitable."

YIELD AND MARKET VALUES

The average yield of white pine in the white pine type in the Kaniksu and Coeur d' Alene National Forests in Idaho is 8,000 to 30,000 board feet.

From data published by D. T. Mason the current annual growth in mature white pine stands in the Inland Empire averages 50 board feet, the mean annual growth of young stands from natural reproduction averages 150 board feet, and the mean annual growth of young stands from plantings averages 225 board feet.

A yield table for western white pine, compiled by I. T. Haig, Assistant Silviculturist for the Northern Rocky Mountain Forest Experiment Station will be found in the appendix.

At the present time stumpage prices for western white pine are not readily available. Most of the commercial white pine stumpage is in the hands of private companies who do not sell their timber on a stumpage basis, but have their

own mills, and log and manufacture their own timber. It is fair to assume that this condition will continue to exist and that those who might become interested in forest management would be more interested in the average price of white pine lumber for the past 20 to 25 years than they would be in the curve of stumpage prices for that time.

In the appendix will be found a graph of the average F. O. B. mill prices for white pine lumber for the United States from 1899 to 1924, and a graph showing the average F. O. B. mill prices of western white pine lumber for the four leading western states for the same period.

NURSERY TECHNIQUE FOR WESTERN WHITE PINE AT THE WIND RIVER NURSERY, COLUMBIA NATIONAL FOREST.

From the rather limited experience which has been had with western white pine at the Wind River Nursery, it has seemed a rather easy one to handle.

SEASON OF SOWING.

The seed should always be sown in the fall, about October 15-30. If sown in the spring the seed is very slow to

germinate and most of it will hold over until the following year. With fall sowing, prompt germination is secured the following spring.

METHOD.

The seed is sown broadcast, simply because it is the method employed at Wind River for all species.

DENSITY.

It should be the aim to obtain a stand of 3,000 seedlings per bed of 48 square feet, equivalent to about 65 per square foot. This is on the basis that the trees are to remain 2 years in the seed beds. The amount of seed needed to produce this density depends upon its quality, and usually is one-half pound per bed.

DEPTH OF COVERING SEED.

The covering should be one-half inch deep.

ROTATION.

At Wind River a 2-1 rotation is employed, as the seed used comes from 3,500 feet altitude and requires two years in the seed bed to produce a seedling large enough to transplant.

SHADE.

One-half shade during the first year in the seed beds is good practice. None thereafter is needed.

TRANSPLANTING.

Seedlings are transplanted in the spring after the second growing season. They should be spaced 1½ inches apart in rows 6 inches apart.

DISEASES.

No diseases of western white pine have been encountered at Wind River. The species is apparently an easy one to grow, always giving a very satisfactory and uniform grade of stock. In some nurseries damping-off is troublesome but at Wind River this seldom occurs to any considerable extent. Delay in germination is the greatest obstacle but is largely overcome by fall sowing, as already mentioned.

COSTS.

Costs vary greatly depending upon the location, accessibility and character of the planting site, and normally ranged from $8.00 to $13.00 per acre. The former figure applied to the period before the war.

Costs of seedlings per M packed and delivered to the railroad depot at Carson, Washington, have been as follows. These include a proportionate share of overhead and equipment amortization charges:-

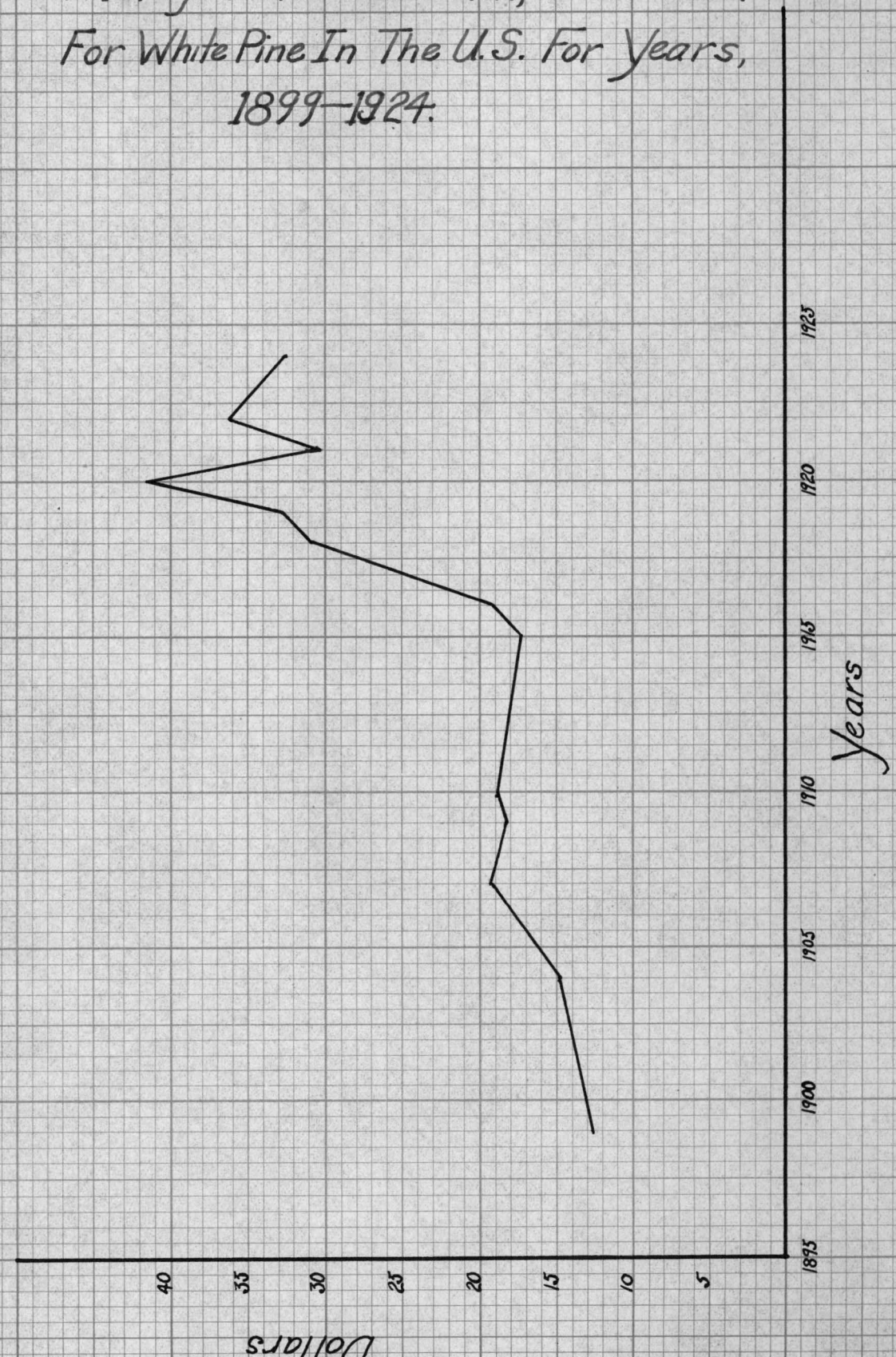
1-1-1	2-1
$11.38	$4.97
6.16	5.24
9.61	5.40
	5.26
	5.90
	9.38
	6.92

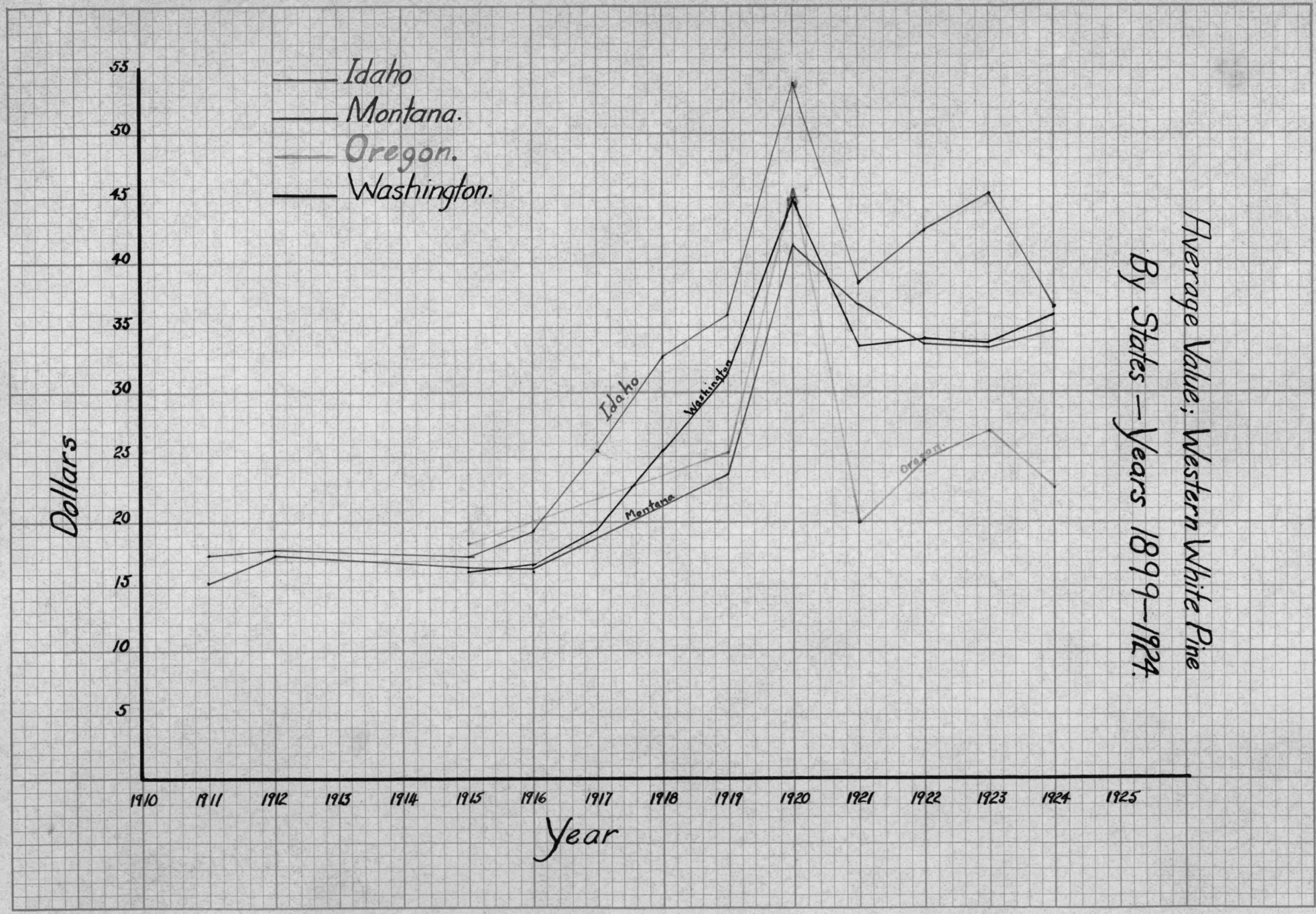
CONCLUSION.

Western white pine due to its inherent characteristics is a valuable timber producing tree.

Western white pine is not exacting in site requirements, makes a rapid growth, produces a large yield per acre at an early age, compared with species found associated with it, is moderately free from damage by insects, fungi and physical factors, has a high market value, and is adaptable to nursery practice and field planting. It is, therefore, a species well suited to forest management.

Lumber Prices:
Average Value At The Mill, Per M. bd. ft. For White Pine In The U.S. For Years, 1899–1924.




Idaho
Montana.
Oregon.
Washington.
Dollars
55
50
45
40
35
30
25
20
15
10
5
1910
1911
1912
1913
1914
1915
1916
1917
1918
1919
1920
1921
1922
1923
1924
1925
Year
Idaho
Washington
Montana
Oregon
Average Value; Western White Pine
By States — Years 1899–1924.

LIST OF WHITE PINE PLANTATIONS OF U. S. FOREST SERVICE IN STATE OF OREGON

J. F. K. 12/28/26

Forest	Location (project)	Species	Date planted	Area in acres.
Crater.	Tallowbox	P.ponderosa & P.lambertiana	1917	15.5
Mt. Hood.	Still Creek	P. monticola & P. taxifolia	1915	60.
	Do.	Do.	1918	290
	Do.	P. monticola & A. nobilis & A. amabilis	1919	275
Santiam.	Battleaxe	P. monticola & P. taxifolia.	1918	480
	Breitenbush	P. monticola & A. nobilis	1919	56
	Do.	P. monticola & P. taxifolia & A. nobilis.	1920	272
	Do.	P. monticola & P. taxifolia.	1921.	357
	7 Mile Hill	P. monticola & P. taxifolia & A. nobilis.	1916	165
Siskiyou	Briggs Creek	P. lambertiana	1911	1.75
	Do.	P. Lambertiana		
		P. ponderosa	1913	28
Siuslaw.	Mt. Hebo.	P. strobus, & P. resinosa & Picea excelsa	1913	208
		P. monticola	1914	.25
		Total acres.		3208.5

LIST OF WHITE PINE PLANTATIONS OF U. S. FOREST SERVICE IN

STATE OF WASHINGTON April 16, 1927.

Forest	Location.	Species	Date of planting	Area (acres)	Latest survival per Acre (trees)
Wind River Branch Pacific N.W. For. Exp. Sta.	Wind R. Arboretum Stabler, Wn.	several sp. of 5-needle pines.	various times past 15 years.	small groups 6-10 tree each.	--
Olympic.	Soleduck Area.	P.monticola A. nobilis in mixture.	1922	73	279
	Soleduck Area	P.monticola A. nobilis & A. amabilis in mixture.	1922	50	279
	Soleduck Area	P. monticola P. taxifolia A. amabilis in mixture.	1922	56	367
Snoqualmie	Buck Creek.	P. strobus	1912	4.5	536
	Buck Creek	P. strobus	1912	3	500
	Granit Mtn.	P. monticola P. taxifolia in mixture.	1913	15	275
	Do.	Do.	1913	46	322
	Do.	Do.	1913	48	213
	Do.	Do.	1913	12	188
	Do.	Do.	1913	11	409
	Do.	Do.	1913	7	20
	Do.	P. monticola	1915	17	388
	Do.	Do.	1915	10	308
	Do.	P. monticola P. taxifolia in mixture.	1915	75	315
	Do.	Do.	1915	32	247
	Do.	Do.	1915	6	429
	Do.	Do.	1915	5	348
	Do.	Do.	1915	9	375
	Long Mtn.	P.monticola	1913	3	679
	Do.	Do.	1913	14	550
	Scenic Area	P. monticola P. taxifolia in mixture.	1916	7 plots $\frac{1}{4}$-$\frac{1}{2}$ acre each	200 to 400
Wenatchee	White pine Cr.	Do.	1918	300	267
	Whitepine Cr.	Do.	1916	7	600

Number of Trees per Acre - Stand 1" and up.

	Site Index.							
	20	30	40	50	60	70	80	90
Age			Poor	Fair	Good	Excellent		
Years				Number of Trees.				
20	21,300	15,800	11,500	7,800	4,700	2,800	2,050	1,620
30	14,550	10,950	8,050	5,220	3,180	1,940	1,420	1,110
40	10,170	7,750	5,600	3,650	2,210	1,370	1,000	775
50	7,400	5,600	4,070	2,680	1,590	1,000	720	570
60	5,490	4,150	3,020	2,000	1,190	760	540	430
70	4,190	3,180	2,300	1,550	930	580	410	330
80	3,310	2,500	1,830	1,230	720	450	320	260
90	2,690	2,030	1,460	990	580	360	260	210
100	2,200	1,700	1,210	820	480	300	215	175
110	1,920	1,480	1,060	720	420	260	190	155
120	1,780	1,350	980	660	390	240	170	140
130	1,700	1,290	930	630	370	225	165	130
140	1,650	1,250	910	610	355	220	160	125
150	1,620	1,220	900	600	350	215	155	125
160	1,600	1,210	890	590	345	215	155	125

Compiled by - I. T. Haig

Assistant Silviculturist

Northern Rocky Mountain Forest Experiment Station.

September 1927.

YIELD TABLE FOR WESTERN WHITE PINE

Volume per Acre - Stand 8" and up.

Age Years	Site Index 20	30	40 Poor	50 Fair	60 Good	70 Excellent	80	90
	Volume - board feet, Scribner Rule.							
20	---	---	---	---	---	---	---	---
30	---	---	---	---	150	450	1,200	1,750
40	---	---	50	400	1,700	3,900	6,200	9,000
50	50	250	900	2,500	6,000	11,100	16,400	21,300
60	,500	1,100	2,900	6,550	13,100	21,650	29,700	36,900
70	1,500	3,150	6,550	12,300	22,500	33,750	44,300	52,600
80	2,900	6,000	11,300	19,500	32,750	46,500	58,200	67,100
90	5,200	9,600	16,800	28,000	43,300	58,300	71,300	80,800
100	7,900	13,600	22,600	36,300	53,500	68,500	82,500	93,500
110	10,500	17,500	28,300	43,700	62,100	77,500	92,000	104,500
120	12,500	20,800	33,100	49,500	68,700	84,750	99,400	112,800
130	14,050	23,350	36,750	54,100	73,600	90,500	No data	No data
140	15,250	25,400	39,400	57,900	77,600	95,100	" "	" "
150	16,200	27,000	41,500	60,600	80,900	98,500	" "	" "
160	17,000	28,200	43,250	62,300	83,750	100,500	" "	" "

Compiled by I. T. Haig

Assistant Silviculturist

Northern Rocky Mountain Forest Experiment Station.

September 1927.

BIBLIOGRAPHY.

Pinchot, Gifford. Western White Pine. U.S.D.A. Silvical Leaflet no. 13.

Weir, J.R. & Hubert, E. E. A Study of the Rots of Western White Pine. U.S.D.A. Bull. No. 799-1919.

Sproat, H. Do Sheep Eat Pines. Nat. Wool Grower. Jan. 1926.

Larsen, J. A. Methods of Stimulating Germination of Western White Pine. J. Ag. Research. Nov. 1925.

Ninman, N. N. Effect of Pasturage on White Pine Reproduction and Timber Quality. J. For. May, 1927.

Wahlenburg. W. G. Fall Sowing and Delayed Germination of Western White Pine Seed. J. Ag. Research, June, 1924.

Fitzgerald, O. A. Harvesting Idaho's Virgin White Pine Crop Am. For. August, 1924.

Zon, Raphael. Seed Production of Western White Pine. U.S.D.A. Bull. 210, 1925.

Mason, D. T. Timber Ownership and Lumber Production in the Inland Empire. 1920

U.S.D.A. Statistical Bull. No. 21. 1925.

Martin, J.F. White Pine is Profitable if Protected From Blister Rust. U.S.D.A. Misc. C. 40. July 1925.

Sudworth, G. B. Check List of the Forest Trees of the United States Their Names and Ranges. March, 1927.

Sargent. Trees of North America.