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"Pruning Second Growth Douglas-Fir"

- A Thesis -

"Pruning Second Growth Douglas-Fir"

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"Pruning Second Growth Douglas-Fir"

Introduction:

The information collected and filed in this thesis is for the purpose of finding a method by which we may obtain the highest possible rate of production of clear lumber. This may be done by increasing the quality of our second growth stands, by pruning the trees to get the clear lumber in young forests. Although pruning is not a common practice in the Northwestern United States as yet, the information given herein may be of some value when it is possible to practice more intensive Forestry.

In order to produce clear lumber in short rotations, the Forester must resort to pruning. As soon as the virgin stands of timber are exhausted, pruning will be a method of getting clear material on comparatively short rotation.

The data presented here is from my field experiments in comparison with other experiments in this field. The data on the experiment is comparatively short, covering only a 6 year period. This is really not enough time to draw accurate conclusions for the pruning.

The field data presented here is from filed experiments on two field plots in the MacDonald Forest, located seven miles north of Corvallis on highway 99 West. Plot No. I is made up of seventy club pruned trees with a check taken on each individual tree for a period of six years. Plot No. II consists of three different methods of pruning.

Ten trees were pruned by axe method, ten by saw and ten by club method. The results are given on each tree by number under, Field Data.

(1) Pruning Douglas-Fir: Immature stands of Douglas-Fir are desirable for pruning from the time the limbs of the crop trees are dead to a height of 18 feet until the crop trees reach a diameter of about 20 inches. Stands younger than this are expensive to work for the benefit do done, and stands older than this, are likely to be harvested, before enough clear wood is added to justify pruning.

Knots and the Desirability of Pruning Douglas-Fir:

Lumber comes from three different zones in a saw log. The first zone or inner core of the tree has the tight knot or core knot. These are contained in the portion of the tree that has grown before the lateral branches died and fell off. The tight knot is graded down the least of all knots as it is small and usually solid. Second comes the part of the tree that has the encases or loose knots. Here the lumber is graded down as loose knots fall out and reduce both appearance and strength a great deal. (7) Intergrown knots are ones where the annual rings are completely intergrown with the wood surrounding them. Encased knots are those where the rings of each years growth are not intergrown with those of the surrounding wood.

The clear zone of wood in a tree is the most valuable. It is used for many purposes, most important being interior house finish and flooring. Therefore if trees only have a very thin band of clear material, they are just starting to produce the profitable part of the log. In Douglas-Fir the clear material may consist of yellow or red fir. Yellow fir consists of slow grown material and therefore has a great deal more use due to its weight and fineness of structure. Red fir is a hard, fast growing material and does not take nails well without splitting.

Natural Pruning in Douglas-Fir:

Natural pruning of Douglas-fir depends on the dying and falling off of the lower branches and any protruding portion of a limb that is left. The density of stocking in the stand or the tolerance of the tree has the most influence on natural pruning. The rate and degree to which a tree prunes naturally depends largely on the ability of a limb to continue in the growth effort. However it is not always the intolerant trees grown in closely stocked stands that prune best. There are a number of factors influencing natural pruning. These factors are resistance to decay and climatic conditions such as snow, sleet, ice, and wind.

The length of time required for natural pruning varies a great deal. It may take several years or in open stands the limbs may never fall. A lot depends on size and vigor of those lower branches.

However usually, the lower branches tend to die and in time fall off. Regions of heavy snow fall and other natural factors speed up this process.

Supplementary Value in Pruning:

Pruning helps aesthetic value. It tends to beautify the forest giving an open clear appearance. Forests owned by the Public will probably some day be pruned both for beautification and value of lumber. Pruning, for this reason will probably be more important in the future than it is at present.

Grazing Value:

With the lower limbs removed and light allowed to penetrate to the ground to a larger extent, grazing becomes somewhat important. With the opening of the stand due to pruning, forage plants show much better growth and increase the grazing value. Stock may move through easier and this balances the lack of heavy forage to a sufficient degree. Douglas-fir forests are not the best sites for forage plants as growing conditions are poor.

Fire Hazard Reduction:

The removal of pruned limbs both living and dead tend to cut the accumulation of fuel whose tendency it is to build up head, causing crown fires. If the pruned limbs are piled and burned the fire hazard is reduced to a great extent and will cut fire loss. Also if there is a grass fire it will have less chance of being hot enough to kill the trees.

A New Method of Pruning:

At the Kiev's Forest Institute in Russia, Knotkevich (2) has developed a method for obtaining even more clear wood than by ordinary pruning. Beginning with 8 year old pines, he removed the lateral buds from the new leading shoots each succeeding year so that branchless stems were produced to a height of 6 to 7 meters. Further growth of the trees was allowed to proceed in a normal manner.

The cost of this method is claimed to be relatively low requiring a total of 60 to 80 hours of work to produce 400 knot free stems per hectare (160 stems per acre). No tools except a light ladder for reaching the shoots, are required. In the pine trees, the wounds resulting from the removal of buds were quickly sealed by resin and infection by fungus prevented. Healing of the wounds followed in a few weeks. (2)

Experiments Pruning Eastern White Pine and the Average Cost and Ratings of Tools in the Final Test:

The California five and one half point saw requires 63 seconds for 0-7' pruning. From 7' to the crown is 330 seconds. It is the best tool. Tree damage, fatigue and other hazards are very slight in all the tools mentioned here. The carpenter's six point saw requires 87 seconds from 0-7' and 400 seconds from 7' to the crown. This is the second best tool. The third best tool is the Butcher seven point saw requiring 71 seconds for 0-7' and 422 seconds from 7' to the crown. (4)

Power Pruning:

A light-weight power-driven pole saw has been developed at the Forest Products Laboratory. This power pruner promises to make pruning a more practical part of forest management, affording additional work and more than repaying its cost in the shorter rotation required to produce high quality lumber.

Results of Pruning to Different Heights in Young Douglas-Fir:

The age at which and extent to which it is advisable to prune young Douglas-fir are as yet unsolved problems, but some specific information is now provided for one age class by a study started in 1937 on the Wind River Experimental Forest in Southern Washington. (6)

The pruning was done on a site III, 28 year old stand of pure Douglas-fir, that followed logging and slash burning. Two hundred crop trees were used in the dominant and co-dominant class. Only healthy trees were selected. The stand had an average diameter of 5.5 inches and an average height of 40.6 feet. One of the treatments listed below was assigned to each crop tree by random selection. The limbs and branches were cut off flush with the bowl with a saw in the late fall of 1937, workmen using ladders.

In December 1943, measurements were again taken of the height and diameter and observation made of any sunscald injury or epicormic branch development. The results for the several treatments for the six year period are

shown in the table below.

Table Showing Sunscald and Epicormic Branching. 1937-1943:

Extent of Pruning	Average Growth DBH-In.	Ht.-Ft.	New Branch Development of Tree % of Trees	Sunscald % of Trees
Dead limbs only	1.1	9.2	0	0
¼ of live crown	1.2	9.4	2	2
½ of live crown	1.0	7.9	0	12
3/4 of live crown	.5	5.3	15	35

Organization of Work:

Plans:

After a pruning project has been approved, the Forest Supervisor should have prepared for the guidance of the project leader, a plan of action which should describe the area to be treated, the methods to be employed, the size and organization of the crew, tools to be used, and the records to be kept. This will serve as instructions in both field work and record keeping for the project leader and his crew foreman.

Crew Organization:

Every stand improvement crew should be in charge of a technically trained or experienced man. It should be his duty to train each member of his crew to perform specific tasks. It should be the foreman's job to allocate the duties in such a manner as to provide a balanced crew where no man should have to wait on another.

Field Procedure:

In most cases it will be necessary to cover the area

in strips, the width of which will depend on the type of work, size and kind of crew, topography, and other factors. Therefore, the preliminary surveying and laying out of strips should be the first step and it should be kept ahead of the pruning or cutting workmen. The strips need not be run in cardinal directions, but may be laid out in consideration of topography and transportation routes. Ordinarily the cheapest and least confusing method of marking the strip is to lay white cotton strings on each boundary line. This obviates promiscuous blazing and is conspicuous. The purchase of string is covered under "Tools" below.

In thinning and pruning the first men to follow the surveyors on the strip are those who designate the trees to be pruned or released. They may do some work themselves but it is usually advisable to have a few of the best men do nothing but the all important work of selection and marking crop trees for treatment. In all cultural work the best men should be in the front selecting the trees for treatment, while the less experienced follow behind and execute the manual labor. In marking crop trees blazing should be avoided. Sometimes the spotters should mark the crop tree by pruning of the lower few feet, while in other cases pieces of cloth, paper, dabs of paint, or a paint spray may be used for marking each tree. (1)

Pruning Equipment:

In my experiment, climbing equipment was used in

all cases due to the height of limbs to be pruned. The trees were pruned to the first live limbs. Hand tools, used in the experiment and their relative merits are:

1. Club: no particular significance may be attached to this, except its weight and shock resistance. The type was usually oak, hickory or ash, in the form of a hazel hoe, peavy or mattock handle cut down to an 18 to 24 inch club. Its nearest likeness to a patented tool is the Forest Service's 'Hebo Club'.

2. The Hebo Pruning Club:

   The Hebo Pruning Club is a new and very simple tool particularly well adapted to close and fast pruning of pole and piling size trees. The tool, as the name implies, is a club consisting of a mattock, hazel hoe, grub hoe or pick handle shod on the end with a piece of 1/8 inch thick steel. The length of the ferrule and of the handle vary depending on the pruning method by which the tool is to be employed. When the tool is used in two hands as it is when pruning from the ground, the ferrule is 8 inches and the handle 33 inches long. When the club is to be used in one hand by a climber, the handle is 17 to 19 inches long and the ferrule 5 inches long. (Fig. 1)

The limbs are severed by a blow at or near the branch collar. One blow is ordinarily sufficient to break off a branch up to 1 inch in diameter, but 2 or 3 blows are usually needed to break off larger branches.

Preliminary studies indicate that the tool is appreciably faster than the best available pruning saw whether used from the ground, ladder, or in the spur climbing method. Another no less important advantage of this tool is close pruning which leaves only a small scar. This was not possible before with any other pruning tool, except at a great expenditure of time. The club has been used mostly in the Douglas-fir region and has been found to be a highly satisfactory tool for pruning this species.

3. Cruising Axe:

This was used for speed as it is slightly faster than the club on larger limbs due to its shearing power and weight. The scars were not as clean however as the axe tends to leave a larger stub due to inaccuracy of striking the limb flush with the bark. The axe also has a tendency to turn outward as it shears through the limbs. Care must be taken because the axe is extremely dangerous.

4. Pruning Saw:

The curved back saws were used. The most successful were a short 14 inch, eight tooth saw for the small limbs and a larger 20 inch, five and one half tooth saw for the larger limbs. The saws were both of the pull type with a great deal of set in the teeth. The limbs were first notched underneath and then cut through from above. This caused a clean break preventing leaving a stub on the tree trunk. The large type saw was faster and better for the larger limbs but the club was faster on smaller limbs by a small margin. The saw method is reasonably free of danger, but care should be taken in the handling of the saw. Oil should be used at intervals to speed up work and keep the saw in good condition.

Defects in Pruning Practice:

The defects in pruning are largely due to the workmanship of the person pruning the tree. In some cases there will be few defects, other times there will be many defects. Thus it is largely dependent on the quality of the work done. These defects are as follows.

1. Branch stubs are a considerable defect in any pruning project. Not only does it cut down the amount of clear lumber produced in saw logs but also the grade of lumber produced in the log. Rot may enter the pruning

injury and cause considerable damage to the tree. Under good pruning practice, entire limbs are removed without leaving a large scar or fungus entrance.

2. Stripped bark: sometimes large strips of bark are torn from the tree thus allowing entrance of decay orgamisms. This happens only in live limb pruning as dead limbs are free of the tree's growing bark. This can be largely remedied by careful undercutting of the limb. This is easier to do with a saw than any other tool. It can be done by the ladder or spur method much easier than with a pole saw.

3. Pitch pockets are usually caused by an accumulation of resin due to an uneven wound in pruning especially in green branch pruning. Trees pruned late in the season may have heavier resin flow than those pruned early in the season, therefore when the annual growth rings cover the wound, it covers the resin accumulation forming a pitch pocket.

4. Sunscald may result either from opening the stand up with a thinning and pruning operation combined or if too many live limbs are removed opening the bole of the tree to direct heat rays. The result is damage due to overheating and drying out of the inner bark and cambiam layer. If this layer is too greatly effected it results in stunting and killing the tree.

Cost of Pruning:

In my club pruning plot number 1, the cost of pruning was very reasonable. Figuring 75 cents an hour for pruning labor, the cost of pruning an average tree would be rather low. In plot number 1, an average of seven trees an hour were pruned on the plot giving an average of 11 cents per tree. If the pruner has to judge the trees that were best in the stand and make an even distribution of pruned trees, the cost would run closer to 15 cents per tree. if one uses the usual pruning spacing of 400 square feet to the pruned tree, the cost of 110 trees to the acre would be about $12.10 per acre.

In my club pruning plot number 2, with the trees having an average diameter of 12", which is about the maximum size profitable to prune, the cost ran considerably higher due to number and size of limbs and height to which the trees were pruned. Only two trees per hour could be pruned here, therefore the cost of pruning each tree was about 38 cents and resulted in a cost of $41.80 per acre which is a very high pruning cost. If one wishes to get a return out of this old a stand one will have to hold the trees a longer time to gain any interest over investment.

Report on Two Pruning Experiment Plots.

Tree Selection Practice:

Trees were selected more to get data of healing than for commercial data. Trees of healthy appearance and

relatively well established, were used. These trees were pruned to the first general live whorl of branches. In some cases a few live limbs were pruned. The trees were not pruned too high in cases of stems smaller than 4" at the upper dead branch limit due to spurs and safety of trees smaller than that. Also the possible damage of spurs to the tree. In the experiment, all the healthy dominant and co-dominant trees in the plots were pruned. Some of the trees in the plots tended to be staggnated due to the stocking.

Summary:

The purpose of this thesis was to complete a study of pruning second growth Douglas-fir as a sound sivicultural practice and to present detailed data on several methods of pruning. One's aim should be to select a pruning method which combines economy with efficiency and ready healing.

Before a pruning project is started, the pruner should consider the following questions.

1. What type of trees shall be pruned.
2. The number of trees per acre to be pruned.
3. The height of the bole to be pruned.
4. Cost per acre under stated conditions.
5. Will the pay in principle and interest be worth the pruning.

The following recommendations should answer these questions. If they do not, a special pruning study may be necessary.

1. The crop trees selected should be of the dominant or co-dominant crown class. These trees should be of the best form and rapid growing specimens.

2. To facilitate the quick formation of clear wood, only thrifty young trees should be pruned. The pruning should be carefully handled.

3. The pruning should be done during the dormant season. The best time is just before the spring season

growth starts. Late winter til spring is usually the best time.

4. The trees should be from 5" minimum to a maximum of not more than 11 or 12" in diameter.

5. The number of trees to prune per acre depends on the diameter at which you figure on harvesting the trees. A figure of between 100 and 150 trees per acre could be used under ordinary conditions.

6. The cost of pruning in the experiments ranged from 15 cents per tree for a height of 50' to 33 cents per tree in maximum size tree of 12" diameter at 60' height.

7. Limbs should be cleaned up in the best way possible, probably piling and burning being the most economical.

8. In the two experiments that were tried, only dead limbs were pruned, however from different sources of data, I found that in some cases where 25 percent of the live limbs are pruned, an increase in growth and a quicker response to healing results.

9. Most economical pruning should not be over the first 16 or 32 foot log as here is the most diameter growth and speed of pruning which makes a more economical project for value returned.

10. To secure uniform and exact work of pruning all the crew members should be under close supervision.

11. The best tools to use were found to be a five and one half tooth pull type handsaw and a form of Hebo Club, both having relative merits involved.

12. Tree spurs or pole saws seem to be the most economical method of pruning in Douglas-fir due to topography and ground cover.

13. Safety rules should be followed to protect crew members. Individuals should work far enough apart to prevent accidents.

14. The healing ability and time for the wound to heal is largely due to care in pruning and to how much wood is being put on by the tree. In dead limb pruning, 10 years is about the average time for healing of pruning wounds.

15. The pruning should be most carefully completed, preventing branch stubs, pitch pockets and stripped bark.

16. To make pruning of dead limbs profitable the price of clear lumber or veneer will have to be quite high in relation to knotty classes of lumber.

17. Supplementary values of pruning such as aesthetic value, grazing improvement and fire danger reduction should be considered in the cost price of pruning.

18. Natural pruning may only be relied on in a few closely grown stands of pure Douglas-fir.

Field Data:

Club Pruning in Plot Number I:

All trees were pruned to an approximate height of 60 feet and tree spurs were used. Diameter measurements were taken outside bark.

No.	Age	Class D & C	Healing	Growth	Dia. 1947	Dia. 1940
1.	49	C	50%	.6	10.5	9.9
2.	51	D	70	1.0	14.4	13.4
3.	53	D	65	1.0	10.2	9.2
4.	41	C	75	1.0	10.1	9.1
5.	60	D	40	1.0	16.0	15.0
6.	48	C	75	1.1	9.1	8.0
7.	53	D	50	.8	10.5	9.7
8.	41	C	60	1.5	7.2	5.7
9.	49	C	50	.7	10.7	10.0
10.	52	D	70	1.5	14.6	13.1
11.	59	D	50	.6	12.3	11.7
12.	60	D	40	.7	14.5	13.8
13.	58	D	50	.5	10.2	9.7
14.	51	C	50	.7	9.3	8.6
15.	50	D	60	.9	9.1	8.2
16.	29	C	60	1.3	6.5	5.2
17.	53	D	65	1.3	14.1	13.8
18.	38	C	50	.8	5.2	4.4
19.	37	D	40	1.0	12.6	11.6
20.	59	D	40	.8	13.0	12.2
21.	47	D	60	1.5	11.2	9.7
22.	57	D	30	.5	10.3	9.8

No.	Age	Class D & C	Healing	Growth	Dia. 1947	Dia. 1940
23.	49	D	60%	1.7	13.1	11.4
24.	46	D	40	1.0	12.2	11.2
25.	43	C	40	.6	6.6	6.0
26.	49	D	40	1.5	12.7	11.2
27.	45	C	50	.8	10.2	9.4
28.	42	C	55	.8	8.8	8.0
29.	54	D	45	1.0	14.2	13.2
30.	46	C	25	.7	7.8	7.1
31.	49	C	40	.6	8.9	8.3
32.	51.	D	50	1.8	13.0	11.2
33.	58	D	40	.8	12.2	11.4
34.	60	D	60	1.3	12.6	11.3
35.	50	D	60	1.5	14.5	13.0
36.	51	D	55	1.8	12.2	11.4
37.	49	D	60	1.0	15.1	14.1
38.	51	C	40	.8	10.6	9.8
39.	40	C	40	.8	6.3	5.5
40.	50	C	40	1.0	10.4	9.4
41.	52	C	20	.6	7.7	7.1
42.	47	C	30	.5	8.1	7.6
43.	50	C	40	.5	7.1	6.6
44.	51	C	40	.4	7.3	6.9
45.	43	C	30	.5	6.6	6.1
46.	52	D	40	1.5	12.9	11.4

No.	Age	Class D & C	Healing	Growth	Dia. 1947	Dia. 1940
47.	50	D	60%	1.4	11.5	10.1
48.	50	D	40	.5	7.1	6.6
49.	60	D	50	.6	15.3	14.7
50.	50	C	40	.5	8.4	7.9
51.	52	D	50	.7	12.2	11.5
52.	45	C	60	1.5	9.2	7.7
53.	48	C	60	1.2	8.3	7.1
54.	51	C	30	1.0	8.1	7.1
55.	44	C	45	1.2	6.0	4.8
56.	48	C	30	1.2	10.1	8.9
57.	48	D	65	1.8	10.0	8.2
58.	50	D	40	1.7	10.2	8.5
59.	54	C	40	.8	8.1	7.3
60.	52	D	30	1.0	9.7	8.7
61.	55	C	40	.8	9.8	9.0
62.	51	D	30	1.0	12.4	11.4
63.	35	D	40	1.0	9.5	8.5
64.	55	D	30	.7	12.3	11.6
65.	43	D	75	2.0	11.5	9.5
66.	54	C	30	.7	11.4	10.7
67.	55	C	40	.5	7.5	7.0
68.	51	D	40	1.7	11.6	9.9
69.	56	D	55	1.7	14.4	12.7
70.	54	D	50	2.0	12.5	10.5

Field Data Continued.

Hand Saw Pruning:

In this study a hand saw of the Atkins #23 or Fanno #4 type was used. The saw having a five and one half point per inch draw cut. The blade was 14 inches in length. Plot number II. The measurements in the table below were taken outside the bark.

No.	Age 1940	Class D & C	Healing	Growth	1947 Dia.	1940 Dia.
71.	68	D	30%	.5	21.3	20.8
72.	53	D	40	1.8	21.6	19.8
73.	73	D	30	.8	28.7	27.9
74.	55	C	35	1.0	19.2	18.2
75.	65	D	25	.6	20.3	19.7
76.	58	C	35	1.3	20.0	18.7
77.	54	D	25	.5	15.1	14.6
78.	52	C	40	1.5	21.0	19.5
79.	54	C	25	.5	27.2	26.7
80.	60	C	25	.7	22.5	21.8

The trees were climbed with tree spurs and the bowl was pruned for approximately an average of 60 feet in height.

Field Data Continued.

Club Pruning:

A typical hardwood club was used to prune with, without the ferrule that is used in a Hebo Club. The trees were climbed with tree spurs and pruned to an approximate average height of sixty feet. These trees are found in pruning plot number II. Measurements were taken outside bark.

No.	1947 Age	Class D & C	Healing	Growth	1947 Dia.	1940 Dia.
81.	50	D	55%	1.4	17.2	15.8
82.	58	D	70	1.3	20.1	18.8
83.	60	D	50	1.2	22.3	21.1
84.	63	D	45	1.0	22.1	21.1
85.	55	C	20	.4	11.0	10.6
86.	55	C	20	.4	13.7	13.3
87.	62	D	50	.8	18.2	17.4
88.	50	C	15	.5	15.5	15.0
89.	77	D	40	.9	26.0	25.1
90.	54	D	40	.6	21.2	20.6

Field Data Continued.

Axe Pruning:

Here a small cruising axe of the single bitted type was used to do the pruning. The trees were climbed with the aid of spurs and pruned to an approximate average height of sixty feet. Either side of the axe being used. The blade for shearing the limb off or the blunt side to knock the limbs off. The measurements below of axe pruned trees in plot number II were taken outside bark.

No.	1940 Age	Class D & C	Healing	Growth	1947 Dia.	1940 Dia.
91.	62	D	20%	1.0	24.1	23.1
92.	70	D	15	.7	26.5	25.8
93.	60	D	20	.5	24.0	23.5
94.	80	D	35	1.3	32.7	31.4
95.	86	D	10	.6	33.2	32.6
96.	55	C	30	.3	11.6	11.3
97.	74	C	25	.5	24.3	23.8
98.	71	D	25	1.2	23.2	22.0
99.	52	C	25	.8	11.8	11.0
100.	54	D	40	1.8	19.0	17.2

Recommendations:

Future of Pruning in Douglas-fir:

Pruning of Douglas-fir as a common practice is in its infancy. As a result only general suggestions of tools and methods are listed. Since no real long term practices are available, only experiment data can be used to aid in judging the problem.

Open grown, limby Douglas-fir occurs generally over the Pacific Northwest. In a good deal of these areas good site quality of land is available, insuring a favorable increment for tree healing. If the tree is pruned during a rapid growth period, healing is fast and comparably safe from fungi infection.

As a starting point for foresters and forest owners who are interested in high return for their choice trees, it will undoubtedly appear as a safe investment to put their own or hired help to work during off season, pruning select trees in their stands. At a future date it will probably be possible to determine labor cost, and prospective market prices will make forest pruning profitable.

Probably in the near future complete pruning rules and desired equipment will be listed for each species and type of timber tree. Such rules will specify desirable height to prune trees, age at which most economical to prune and methods and equipment most economical to use in practise. With this information there will be an average cost of various methods. It will list average cost and expected increase in the quality and value of the resulting forest products.

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