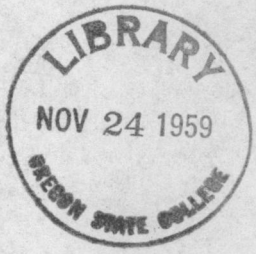

SILVICULTURAL AND FINANCIAL CONSIDERATIONS OF PLANTATION GROWING OF CASCARA

Silvicultural Project Report

by
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Preface

There is much lacking in the way of scientific knowledge about the subject of this paper, cascara. What has been written on it is only an outline as far as managing the tree is concerned. There is much room for experimentation in this field, but experiments of this nature take time, and experiment stations have not found a place in their curricula for cascara as yet.

If cascara plantations can be a profitable enterprise, and there are no good reasons why they cannot be as long as the market is not flooded, then the scientific knowledge will soon be sought after by those who are interested.

This paper does not purport to give the final work on the subject, but it is hoped that it will present the basis on which cascara plantations are to be managed, and what the owner may expect in returns from his plantation.

Besides the references cited in the Bibliography, the authors have received information by correspondence with the State Forester in Salem, Oregon; from the I.P. Callison and Sons (Drug Company), from the Forest Management Research Department of the Pacific Northwest Forest and Range Experiment Station, from the Regional Forester of the Pacific Coast Region with the Soil Conservation Service, from numerous papers from the State of Oregon Department of Forestry, and from the Western Crude Drug Company in Portland, Oregon. This and the information given us by Thomas Miller, owner of a plantation of cascara at Brownsville, Oregon, has been invaluable to the authors in the compilation of this report.

Introduction

Use

The extract from cascara (Rhamnus purshiana) bark and wood has properties of a cathartic and laxative which make it valuable as a drug. These properties have long been known, but cascara has only recently come into general use for this purpose.[1]

Cascara increases the secretions of the gastro-intestinal canal, and at the same time has a bitter principle which acts as a tonic to improve the appetite and digestion, and tends to prevent future constipation. Until the principle of the cathartic and tonic actions is isolated, no mineral compound is likely to come onto the market in direct competition with cascara.[1]

Many commercial laxatives and cathartics have extract of cascara as their active principal. The largest use enjoyed by the drug is in Army and Navy medicinal supplies. It may be expected that in times of high Army and Navy enlistments the demand for the drug will also be high.

History of Cascara

In 1877, Dr. J. H. Bundy of Calusa, California, wrote an article on the medicinal properties of cascara. This

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1. The index numbers used refer to references in the Bibliography.

article introduced it to the medical profession. Probably no single drug gained popularity as quickly as has cascara.[1] After seventy years, it is still of primary importance as a drug.

It wasn't until the drug had gained popularity, that cuttings by peelers was started. The large percentage of cuttings for commercial use has been within the range of the species in Oregon and Washington, with minor cuts being made in northern California and southern British Columbia.

According to correspondence received from the Oregon State Board of Forestry at Salem, there are almost no virgin stands of Cascara of commercial importance today. In 1937, 71,105 acres of the Elliot State Forest in Coos and Douglas counties in Oregon, containing the largest block of cascara remaining in the region, was contracted to peelers who agreed to follow certain rules to safeguard the future of the supply.[2] Details of the present status of the stand have not been received by the authors at the time of this writing.

Since that stand is the only major natural supply of cascara, and since wild stock is not keeping pace with bark requirements[4], commercial plantation assume the characteristics of commercial crops. The success of these enterprises will be dependent upon proper management.

To point out considerations in the management of cascara is the objective of the first part of this paper. The second part will consider the valuation and finances on a theoretical plantation of forty acres.

Part I

Silvicultural Consideration

Part I

Silvicultural Considerations

Cascara is exacting in its soil and moisture requirements, and for this reason the site for a plantation must be carefully chosen to achieve best growth. It grows best in deep, rich, sandy, rocky or humus soils in low river bottoms, flats, valleys and borders of streams.[1] It will occur on drier sites on gravelly or sandy soils throughout its southern range, but it is shrublike in form on such sites.

Good soil drainage is essential, but the soil must be moist at all times. The tree will withstand inundation for some time during its dormant season.

Tolerance

The tree is exceedingly tolerant under forest canopies on moist soil and in humid air. It will not develop rapidly under such conditions, however, and each tree in a plantation should be given full light for fast growth. Such suppressed trees have the power of quick recovery upon being released from suppression, so it is feaseable in management to start new growth under an overstory that is to be removed.

The best development is found in close stands with side shade but with plenty of overhead light.[1]

Cascara is not a fast growing tree, but is more or less intermediate in this respect. Starker and Wilcox[1] give an example of an open-grown tree that had attained a diameter of ten inches and a height of fifteen feet in fifteen years. Another tree in the shade and on a dry site in the Siuslaw

National Forest has only had an increment of seventeen rings per inch.

The climatic conditions favorable to cascara are similar to those of red alder and Douglas fir, its most common associates. It is also found within its range, growing with Western red cedar, hemlock, big leaf and vine maple, Oregon crab and oaks.

Distribution[1]

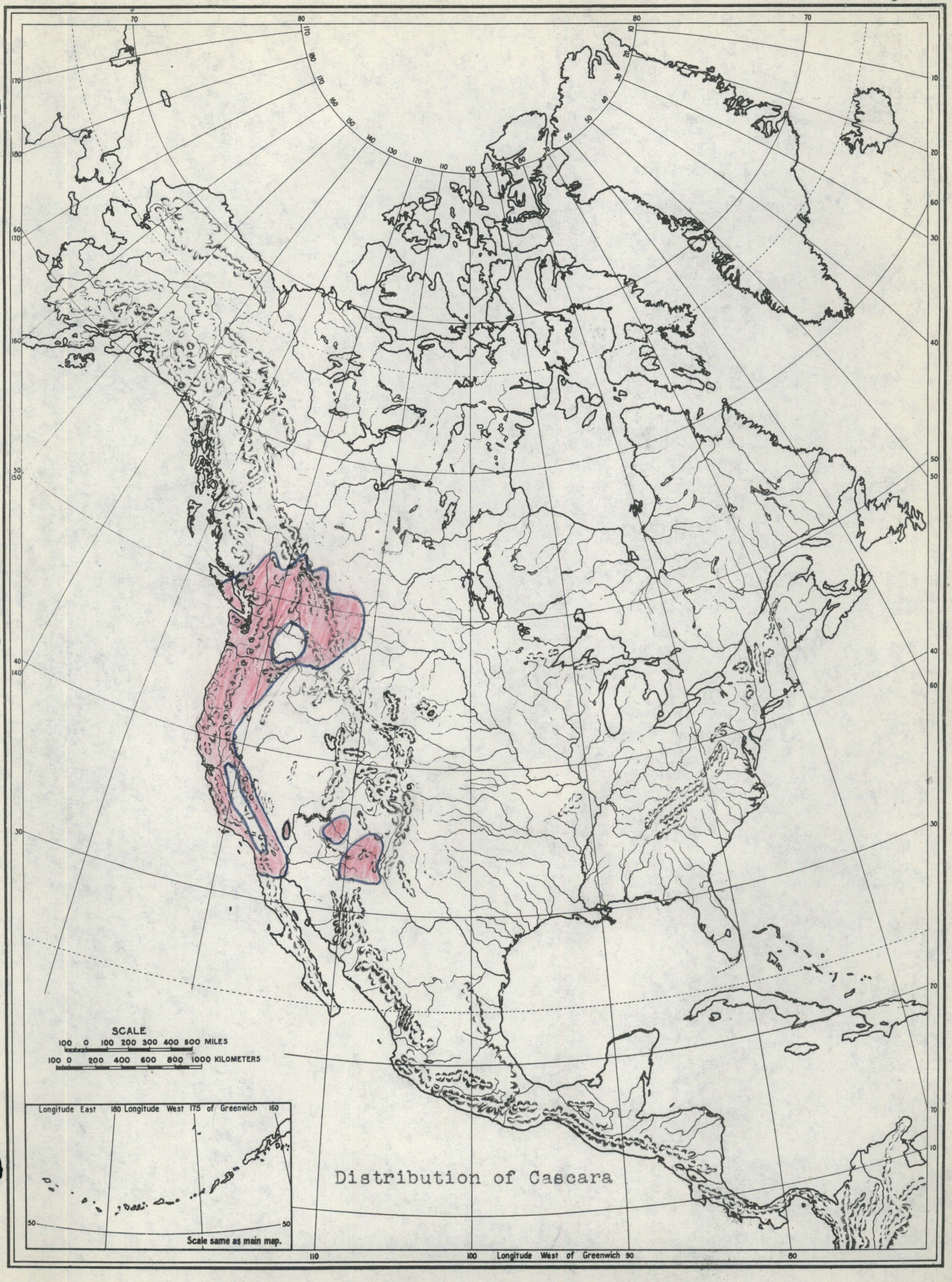
Cascara is widely and generally distributed from the region surrounding Puget Sound, southward to Central California; it extends along the mountain ranges of northern Washington to the Bitter Root Range in Idaho and the shores of the Flathead Lake in Montana. See distribution map.

The commercial range, however, is much smaller in extent, being confined to Northwestern California, Western Oregon, and Washington and Southern British Columbia. Outside of its commercial range, cascara grows shrublike in form, possibly due to climate, soil and other site factors, and does not yield a bark of such high chemical constituents as when grown under optimum conditions.

Inemical Factors

A. Livestock

Grazing cattle, sheep, goats and livestock are probably the chief threat to cascara plantations, especially the young plantation. Fencing is necessary unless the plantation is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Distribution of Cascara
Longitude West of Greenwich

located in a situation where stock cannot get to it.

B. Rodents

Rodents will eat young stock, and unless they are excluded, will entirely destroy a plantation. If there is a high population of rodents in the area, poisoning the area before planting, and placing poison around the area until the trees are above the seedling stage will help remove the menace.

C. Trespass

Trespass by man is another big threat to the productivity of the plantation. Unscrupulous peelers have often entered privately owned stands, removed much bark from the standing trees, and left unnoticed. They ruin the stump for coppice production by not cutting the tree or by peeling the stump. To guard against this damage, the plantation must be located so trespass may be easily observed.

D. Fire

Because the tree has thin bark, tender leaves, and shallow roots, it is easily killed by fire. The heat and smoke of nearby brush fires have resulted in killing trees even when the flames did not come into direct contact with the tree. Reasonable care by eliminating the hazard and risk of fires in and near the plantation is the answer to this danger.

D. Sun Scald

A problem which the plantation manager must consider when harvesting his stand on a partial cut basis, is the possibility of the trees left in the stand being sun-scalded upon being exposed to the direct rays of the sun. No sun-scald has been noticed on trees that have always been exposed to the sun, but previously shaded trees are very susceptible.

The damage resulting from the heat of the mid-summer sun is; killed cambium, dryed and cracked bark, and decomposition of the south-west side of the tree.

E. Drought

Cascara is not easily damaged by drought, although it does not obtain best growth except in regions of medium moisture. Probably thirty inches of rain is the minumum figure for annual precipitation, since the larger trees are found in that rainfall belt. Transplants have survived periods of 65 days without rain, and seedlings have been found on exposed, dry, south slopes. Trees under these conditions have been greatly stunted, however. The precaution to be recommended is to locate the plantations within the minumum limits of the 30 inches of annual rainfall belt, and to avoid exposed southern and western slopes and otherwise dry sites.

The soil greatly influences drought conditions. Even within a region of heavy rainfall, there may not be enough water in the soil throughout the year to support plant growth because of excessive drainage features of the soil. See soil requirements.

F. Desease

Cascara has the advantage of having no known parasitic fungi. It does have however, certain saprophytic fungi that do not appreciably effect the growth of the tree. A whitish-yellow, wet heart-rot similar to that caused by Polystictus versicolor, a very common saprophyte, has been noted attacking an occasional tree. Three others, Polystictus hirsutis, Schizophyllum common, and Stereum sp., have been collected from the dead parts of the trunk and branches and appear to be growing saprophytically as they usually do, and not parasitically.

G. Insects

Insect damage is almost negligeable because it is so infrequent. One unidentified species of scale insect sometimes occurs in abundance on the bark of the tree. These scales produce the effect of making the bark hard to peel because it will not separate from the tree.

Aphis are found on the leaves for short periods of time but cause no noticeable harmful effects. Flat-headed borers attack only old and damaged trees that do not have the vigor to stave-off attack.

Management

Securing Stock

The Oregon State Forestry Department, Salem, Oregon, produces a limited amount of cascara seedlings that are made available to those desiring to establish plantations. Shipments are made from the State Nursury near Corvallis, Oregon, between the months of December 1 and March 1 of the year following the placement of their order.

To grow his own stock, the plantation manager should gather seed when it is fully ripe which is in late July or early August, depending upon the season. Spread the berries on paper or canvas in direct sunlight and allow them to thoroughly dry in order to prevent molding. If artificial heat is used the temperature should not be above 135 to 140 degrees.

In late fall or early winter the seeds should be stratified in order to encourage early germination in the spring, This consists of mixing them with sand, seeing that all are covered and then kept wet during the entire winter. Do not store in a warm place but leave them exposed to the winter rains but cover with burlap to prevent rain from washing the sand from the seed.

The nursery plot selected for the planting of the seed should be so located as to receive the maximum amount of sunlight. Cultivation is the same as for the home garden. Plant in rows about two feet apart and two to four inches apart in the rows as early in the spring as possible to work the soil.

Keep well watered during the summer but discontinue irrigation by the first of September in order to give the seedlings and opportunity to harden off.

By late fall the seedlings should range from eight to eighteen inches in height and are ready for field planting. Do not dig, however, until they are thoroughly dormant and there has been sufficient rain to moisten the soil and prevent damage to roots when digging.

Germination tests run by the nursery are relatively low; usually around 30 percent from seeds from the Thomas Millar plantation at Brownsville, Oregon. Mr Miller says he is able to secure better germination by planting the untreated berry. Further investigation into the methods of seed treatment for germination needs to be carried out to determine the best method.

Other methods of securing stock that may be mentioned are wildlings and layering. The problem of finding sufficient wildlings, and the cost of bringing them to the nursery prohibits their general use. The results of securing reproduction from layering the lower limbs of the trees is also inconsistant.

Establishing the Plantation

The site should have been chosen to meet the requirements of the tree as outlined in the "Silvicultural Considerations," and should not need any special preparation, other then cultivation to loosen the soil, before the seedlings are planted.[5] It would be desireable, however, to have had a legume grown on the site before planting to supply nitrogen to the soil.

If the site chosen is on cutover lands, it is likely that there will be heavy brush on the area. This brush will have to be disposed of by "brush busting" with a caterpillar, by hand-cutting, or by burning. Burning is not recommended because of detriment to the soil, but it is an easy way to get rid of the brush, and a single burn without reburning will not seriously effect the site and may be necessary to rid the area of the brush as well as the slash on the land left after the logging operation.

The age at which the seedlings should be planted depends largely on the site. On moist sites, one-year-old stock will survive, but on dry sites, two year old transplants or root-pruned stock should be used because this stock has better developed root systems. The older seedlings, being bigger, are harder and more costly to plant.

Spacing

If the plantation is on tillable land, it will be desir-

eable to space the trees wide enough to allow the passage of machinery through the trees without doing harm.

Thomas Miller used seven-foot spacing between rows for this purpose in his plantation. Mr. Miller had no criteria to determine the distance between the trees in the rows for best growth, and the two foot spacing of his trees was too close for maximum yield. Crown competition developed, and under all probability root competition also exists.

Seven by seven foot spacing, judging from the average size of the crowns of thrifty, open-grown trees, would be about ideal for rapid growth and utilization of space.[5]

On cutover lands, covered with stumps, exact spacing and alignment cannot be adhered to, but if good judgement is used, the approximate average of seven by seven foot spacing is attained. Seven by seven spacing will allow 889 trees to be planted on an acre.

A disadvantage of the wider spacing is the lengthened period of crown closure, which will mean that the brush will not be suppressed as soon under wide as under close spacing.

Planting

There are several standardized methods of planting that may be used. The trees may be planted by the grub-hoe slit method, or if more care is desired, or if the stock is large, the deep-hole method may be used.[8]

STAGNATION

The above picture, taken within the Thomas Miller Plantation shows the size of trees resulting from stagnation due to too heavy stocking. The trees are 18 years old.

Part II

Valuation of a Cascara Plantation

There are several precautions that must be taken to insure a successful planting operation. Above all, the roots of the seedlings should not be exposed for more than a half a minute to the hot air and sunshine. They should be kept in a container in sphagnum moss or some other material that will retain moisture.

The roots must not be doubled-up in any manner when planted. This may result in a permanently deformed root.

The seedlings should be set in the ground with the root collar at the ground-line. If planted too high, part of the root system will dry out; if planted too deep, the roots cannot take advantage of the higher concentration of nutrients found at the surface of the soil.

Pack the soil firmly about the roots to eliminate all air space about them. If air-pockets exist, the roots will dry out where exposed.

On cutover lands, care must be taken in choosing the spot to plant the individual seedling. Depressions that will fill up with debris and cover the seedlings, mounds of earth that will dry out, areas containing rotten wood, rocks, and other similar spots should be avoided.

Care of Plantation

Three items enter into the care of the plantation after it is established. It should be cultivated to keep the weeds from giving competition to the trees. Legumes may be planted after the trees get a few feet high to furnish nitrogen to

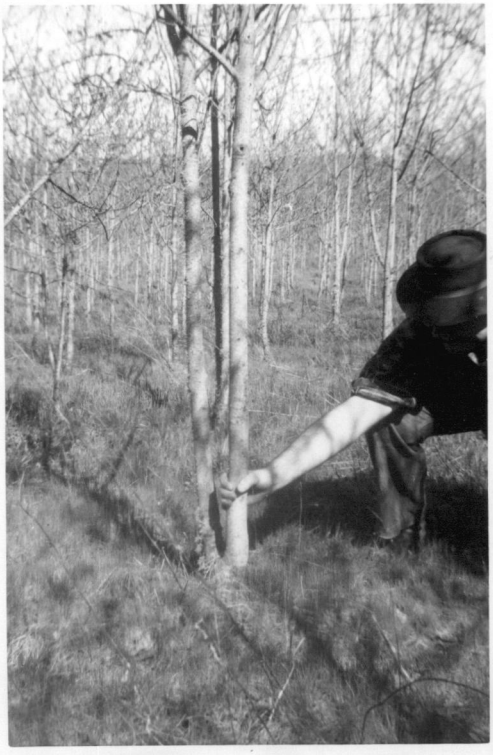
the soil. After about the fourth year, the side branches may be pruned to develop trees with straight boles and clear trunks. Care must be taken to not prune the limbs too high on the bole as to develop top-heavy trees.[2]

Thomas Miller cultivates about five times a year for weed control, and plants peas for a cover crop in the fall which he disks under in May of the following year.

Sometime before cutting, perhaps a season or two before, coppice shoots may be developed on the stumps of the trees to be cut to replace the tree upon its removal. This is done by simply bruising the tree near the gound-line with the blunt edge of an axe. The bruising is done in the winter months.

Harvesting

The trees will be ready to cut from the time they are ten years old and older, depending on when they have reached maximum growth. Thomas Miller's stand has not shown appreciable growth since it was eleven years of age in 1939, as shown by comparison of pictures presented in Marvin L. Helland's thesis.[2] With wider spacing, it is probable the stand would have continued to put on substancial increment in heighth and diameter. The best time for cutting a plantation tree for maximum yield can only be determined by experimentation by plantation managers.



DOUBLE-STEMMED TREE

Two stems from the same stump produces more bark than a single stem. This practice, a result of coppice growth, should increase yield.

Coppice Development

It is suggested by the United States Department of Agriculture that the stump be allowed to sprout four stems or branches, instead of a single trunk from coppice, and that the largest of these be harvested as they become large enough to yield bark. Further experimentation is necessary to determine the feaseability of this process.

Preparing the bark

Different peelers have their own personal peeling instruments, but the most common is a spud, made from an old file or auto spring. As large pieces or strips of bark as possible are taken from the bole, and dried in the sun in this form.[1]

Should the bark be covered with moss or lichens it should be removed before peeling from the bole by rubbing with a gunnysack.

The bark will cure in four days in warm clear weather if placed on a canvas or platform of some sort. The inside of the bark is exposed to the sun to prevent discoloration. Properly dried bark has a clear orange or golden-yellow color and yields the highest chemical tests.[1]

As soon as the bark is thus cured it may be sent to the dealer for further curing, or it may be stored until the end of the cutting season. It will probably be the plantation manager's preference to ship as soon as he has a car-load. Before shipping, the large strips should be

COPPICE GROWTH

This thick growth resulted from bruising the stump of the tree in an experiment for coppice reproduction on the Thomas Miller Plantation.

broken up and placed in gunnysacks, or otherwise bundled.

Thomas Miller has conceived a method of "hogging" the wood of the tree and percolating the extract content from the ground-up chips. He believes the wood will yield 50 percent. as much extract per pound as will a pound of bark.

Part II

Valuation of a Cascara Plantation

The costs of establishment, protection and harvesting the plantation of cascara are calculated in the following pages of this report.

A piece of cut-over land in Benton County which has been recently logged over will be considered as the site for our theoretical plantation. This land is located in the Coast Range where the site conditions are near the optimum for cascara growth. The topography of the area is moderate and the soil is deep.

It was decided to plant part of the area immediately after the slash burn to allow the seedling to get an advance start on any hervaceous growth that may come in later. The reader will realize that the initial establishment of the plantation will throww an additional cost against the first rotation which will not be the case in succeeding rotations.

The acreage to be planted is forty acres. It is planned to grow the crop on a rotation of 16 years. Five acres will be harvested every two years, and this arrangement will place the tract on sustained yield management. Present value of the land has been computed on the basis of a sustained yield management.

In the following analysis all present costs of labor and equipment have been used. Likewise the present price of bark has been used, Although the picture may change before the crop is harvested it is felt that this analysis will indicate accurate relative values.

On some items it has not been possible to obtain accurate data but in the cases of planting and harvesting reliance has been placed on figures in the bulletin, Cascara, by T.J. Starker and A.R. Wilcox.[1] Average growth figures have also been taken from this source.

The following pages contain an itemized account of costs anticipated and an estimation of the gross income likely to be obtained.

a. Cost of the Land

1. Purchase price

The land is to be purchased from a logging company that has liquidated their holdings and and wish to dispose of the property. The average assessed value of cut-over land has been used in this case.

Assessed value of 40 acres @ $5.00 = $200.00 .

2. Taxes

The following estimate of taxes levied against the project was compiled from correspondence with the county assessor of Linn county and personal interview with the county assessor of Benton County. The figure that has been used is an average and it must be realized that it could not be directly applied to a specific piece of property. It is generally representative of the present conditions in the two counties.

In the case of the Thomas Miller plantation at Brownsville, according to the assessor of Linn County, no valuation is placed on the trees. His land is assessed as tillable farm-land, but it is evaluated on the assessments of similar land planted to other crops. There is no attempt to calculate the tax on the amount of cascara bark it will produce. Therefore, the tax rate on cut-over land has been

compiled and no estimate is made on what the assessment will be as the crop increases in value.

The tax averages 40 mills to the dollar, and the assessed value of an acre of land for one year is 20 cents. Therefore, for the 40 acres, the total taxes for one year is

..... $8.00

B. Protection

One of the great factors in the plantation growing of cascara is protection. This includes protection of the investment from animals, man, and fire.

1. Fencing

Due to the fact that this tract is located in an area where stock is being grazed, it is necessary to fence it.

a. Four strands barbed wire at four cents a foot, total 21,120 feet wire required.....$844.80

b. Cedar posts, 16 feet apart at thirty-five cents apiece..... 115.50

c. Transportation of posts..... 50.00

d. Labor
   1. Forty-eight posts per man-day.346.50
   2. Put on wire at one mile per man day..... 39.60

e. Miscellaneous tools and equipment 50.00

Total cost of fencing.....$1446.40

B. Protection (continued)

2. Rodent Control

This item is difficult to determine because the damage which rabbits and mountain-beaver are likely to cause is not easily predicted. Poison grain will be scatted at the entrances of the burrows and along the cat-roads on the area.

Cost of rodent control per year.....$ 2.50

3. Fire protection

Fire trails will be constructed around the area and snags will be felled both within the tract and within 200 yards of the boundary lines. Permission of the owners of adjacent lands will, of course, be obtained.

Estimated cost of fire protection.....$200.00

4. Protection against man

This item will be the most expensive feature of the protection plan. It will be necessary to provide this protection after the first block of cascara is 10 years old. The area will be in full view of the manager's house if possible and no additional expense will need to be entered in such a case.

C. Site Examinationaand Preparation.

This is an item which is hard to evaluate. The first two blocks of trees planted will be set out after the slash burn so there will be little competition from brush and other vegetation. The other blocks will be planted with Douglas Fir to be used as Christmas trees. It is thought that this part of the operation will support itself and need not be levied as a charge against the cascara plantation. The chief reason for planting these trees is to keep out the brush until the cascara seedlings can be set out. Some brush busting may be necessary, but it is thought that these trees will keep out brush at least to a great degree.

A forester will be paid a fee for site examination.

Site examination.....	$ 50.00
Site preparation.....	500.00
Total	$550.00

D. Planting

Planting will be done inthe early spring before root activity starts. Stock will be obtained from the Oregon Forest Nursery. Five acres of the tract will be planted the first year and five more acres will be planted two years later. By the end of the sixteenth year the whole area will be planted. The spacing used will be seven by seven foot with 889 trees being used per acre. Ten percent mortality will be counted on.

Planting (continued)

The life of the planting equipment is sixteen years.

1.	Cost of planting stock for five acres planted every other year with 889 trees per acre; Thousand trees cost $2.50	$11.25
	Plus margin for mortality	3.25
	Total	15.00
2.	Cost of transportation of planting stock shipped every other year	.50
3.	Labor for planting; 54 man days labor at $9.90 a man day	69.30
	Total	$84.80
4.	Cost of planting equipment	50.00

E. Harvesting

A sixteen year rotation is planned for this area. It is estimated that the average tree will attain a diameter of five inches and a heighth of twenty feet in this period. The yield of dry bark per tree will average around twelve pounds.

The total amount of bark harvested every other year will average 10,668 pounds an acre, or 53,440 pounds for five acres.

Two months or 52 days will be required to harvest each crop unit of 5 acres. It is estimated that one man can peel 175 pounds of dry bark per day. Therefore it will require 6 men to harvest each 5 acres. There will be 1,050 pounds of bark peeled per day.

At a wage of $9.90 a man day, the cost of peeling 5 acres will be $3,088,80 every harvest year.

A drying shed will be built to facilitate the handling of this large amount of bark, and a machine similar to the farmers feedcutters will be used for cutting up the strips of bark.

It is estimated that it will require three days to process the bark and to store it.

One man will be employed to cut the bark and spread it on the racks. One of the peelers can probably be used to sack the bark for shipment.

It is planned to contract the hauling of the bark to Corvallis; a distance of 10 miles from the plantation. It is estimated that it will cost $3.00 to carry one ton of bark this distance. There will be 27 tons of bark harvested on each 5 acre block.

As the managers profit is taken care of by the interest rate as used in the computations, this charge will not be itemized here.

One foreman will be hired during planting and harvesting seasons to supervise the field work. It is estimated that the foreman will be hired for a 52 day period every other year.

The costs of harvesting are itemized below;

1. Labor cost for peeling for 5 acre harvest.....$ 3,088.00

2. Cost of cutting and drying equipment
   Cost of drying shed.....$ 1,000.00
   Cost of cutting machine..... 500.00
   Other equipment..... 100.00
   Total for equipment 1,600.00

3. Cost of labor for cutting and drying for 5 acre harvest.....$ 514.80

4. Transportation cost ($80.25 for 27 Tons)..$ 80.25

5. Cost of Foreman (Hired for 52 days every other year) Cost per year.....$ 520.00

Income from bark

The bark will be sold at the current price; $.20 per pound. The amount of bark harvested from each rotation, (sixteen year rotation of forty acres; Five acres harvested every other year) will average 53,440 pounds.

Price received for one years harvest.....$ 10,688.00

Valuation of the Enterprise

From the foregoing itemized costs and income, the value of the enterprise will be determined by the method used in valuating forest lands as given by Management of American Forests,[7] and Forest Economics and Finance.[6] This system breaks the costs and income down into categories as indicated below, according to the number of payments for each item that is to be made, the time between payments of a series of payments, and considering if the payments will terminate at some time or continue throughout the life of the plantation.

Using an interest rate of 6 percent, which should be accurate for an enterprise with relatively high risk, the present value (P.V.) of each item is determined. By subtracting the present value of the costs from the present value of the incomes, it can be determined if the enterprise will be profitable or not, assuming that the estimation of the individual items are correct, and that all influencing costs have been considered. If this value is zero or plus, the enterprise is profitable to the extent that it will net the owner as much as if his money were in stocks or bonds which pay him an interest of 6 percent compounded annually.

The use of the formulas is explained as they are used. Their derivation may be found in the before mentioned references.

Valuation (continued)

I. Payments made every other year.

A. Payments starting with the first year and made every other year thereafter;

1. Site Preparation.....$500.00

(No serious error is introduced by dividing this item by two and computing the present value of "a series of annual payments (of $250) terminating in "n"* years.)

The formula; $P.V. = e\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$

P.V. of item IA $= 250\left[\frac{(1.06)^{16} - 1}{.06(1.06)^{16}}\right] =$ $2,526.48

. . . . . .

B. Payments starting at end of first 16 year period.

1. Labor for peeling.....	$3,088.00
2. Labor of cutting and drying...	514.80
3. Transportation cost.....	80.25
4. Cost of foreman.....	520.00
Total	$4,203.05

This is a "perpetual series of intermittant payments."

The formula; $P.V. = \frac{e}{(1+i)^m - 1}$

Because thes payments do not start for 16 years they must be discounted for that time

Discount formula; $P.V. = \frac{e}{(1+i)^n}$

$$P.V. = \left[\frac{\$4,203.05}{(1.06)^2 - 1}\right]\left[\frac{1}{(1.06)^{16}}\right] = \$13,384.47$$

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* Where n = number of years; i = rate of interest; e = amount of payments; m = number of years between payments in an intermittant series; P.V. = present value of item.

Valuation (continued)

I

C. Perpetual payments, starting at the beginning of the plantation.

1. Cost of planting stock	$15.00
2. Cost of labor of planting	84.80
3. Cost of transporting planting stock	.50
Total	$100.00

Since these are also intermittant payments, the formula is the same as in IB

$$\text{P.V. of item IC} = \frac{\$100.30}{(1.06)^2 - 1} = \$811.49$$

. . . . . .

II Payments made every year

A. Taxes	$8.00
B. Poisoning	2.50
Total	$10.50

This is a "perpetual series of annual payments."

Formula; $\text{P.V.} = \frac{e}{i}$

$$\text{P.V. of item II} = \frac{10.50}{.06} = \$175.00$$

. . . . . .

III Payments made once at start of plantation

A. Cost of Land	$200.00
B. Clearing for fire protection	200.00
C. Site examination	50.00
Total	$450.00

This is present value $450.00

IV Cost of equipment, with sixteen year "life" or period before deteriation.

A. Payment made at start of planting.

1. Fencing	$1446.40
2. Planting equipment	50.00
Total	$1496.40

Stated in this way, this item assumes the characteristics of a series of intermittant payments. See item IB.

$$\text{P.V. of item IVA} = \frac{\$1496.40}{(1.06)^{16} - 1} = \underline{\underline{\$977.93}}$$

. . . . . .

B. Payments made at start of first harvesting

1. Harvesting equipment cost.....$1,600

A series of intermittant payments, discounted for sixteen years.

$$\text{P.V. of item IV B} = \left[\frac{\$1,6000}{(1,06)^{16} - 1}\right]\left[\frac{1}{(1.06)^{16}}\right] = \underline{\underline{\$408.83}}$$

. . . . . .

Income

The first income is at the end of the first rotation (end of the sixteenth year) and is received every other year thereafter.

This is an intermittant series of incomes discounted fo 16 years.

$$\text{P.V. of Income} = \left[\frac{\$10,688.00}{(1.06)^{2} - 1}\right]\left[\frac{11}{(1.06)^{16}}\right]$$

$$\leq \underline{\underline{\$34,035.57}}$$

Conclusion

Valuation (continued)

Summation of payments

Item	Present value
I A	$ 2,526.48
I B	13,384.47
I C	811.49
II	175.00
III	450.00
IV A	977.93
IV B	408.83
Total	$18,734.20

Total present value of income is $34,035.57
Minus costs (present value) - 18,734.20
Profits (present value) above normal..... $15,301.37

Summary

The above shows that the enterprise will be profitable, with a 44 percent return on the investment (value divided by the investment.) The assumptions on such an enterprise are that the plantation yields the maximum amount of bark, and that there are no crop failures. For this reason, the interest rate used might be somewhat low to allow for proper risk of investment.

It is also assumed that the value of bark will not change. Upon development of plantations, the market will be flooded, causing the price to lower. In such a case there will be no profit above the normal when the market becomes stabilized.

A would-be operator should not plan on making as large a profit as the above for the above reason, that the market price will stabilize. The above computations merely show the estimated costs and that such an enterprise is feasible, if all the factors of management and silviculture are favorable.

Some of the costs would be eliminated if the planation were managed in conjunction and adjacent to a farm. In such a case, most of the equipment needed on the cascara plantation could be secured from the farm, and thus better utilization of equipment secured.

An advantage of this type of crop is its time preference. The manager can post pone harvesting to secure better prices, or to secure cheaper labor.

Increased utilization of the cascara tree is a factor that must be considered. In this report we considered the bark only, but if the wood could be ground-up, and the extract obtained therefrom, much greater yield could be secured from this amount of land. Labor cost would be reduced per unit of bark also.

The authors feel that the field of plantation growing of cascara holds distinct opportunities. The production of this drug on plantations may bring about the rise of a minor new industry in the Pacific Northwest. The enterprises could be carried on independently, or has often been suggested, in conjunction with farm or timber management, where-ever a favorable site, not in competition with other enterprises, may be found.

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