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ANNUAL REPORT OF THE SAVERNAC NURSERY

By

D. S. Olson

January, 1916.

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Ag. - Forestry

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PROPERTY OF DIVISION

FORESTRY

COLLEGE OF AGRICULTURE
UNIVERSITY OF CALIFORNIA

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Test. The nursery area is composed of three general
rising above Sprague Creek. The bench on which the main
headed area now existing are located contains 12 acres,
the second bench, also planted in woodlands, containing 8
acres, and the third bench, lying about 40 feet above the
first bench devoted to truck plants, strawberries, truck garden
and hay land, containing 16 acres - total of 26 acres.
The total area is cleared and under cultivation.

Transportation facilities for the nursery are
ideal. The Fallston Trail - a gravel highway -
passes through the nursery; all traffic goes to Chicago on the
Chicago, Milwaukee & St. Paul Railroad, and 17 miles
from the nursery; and all traffic goes to Chicago at
Seneca Spr., on the Northern Pacific Railroad, less than
one-fourth mile from the nursery.

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PREFACE.

In a "Report on Nursery Site" dated July 20, 1909, E. C. Clifford described the location, area, soil, water, etc., of the site which he recommended to be known as the "Savenac Nursery." It is located on the Savenac Administrative Site, Haugan, Montana, in Section 22, T. 19 N., R. 30 W., M. P. M., at an elevation of 3,150 feet. The nursery area is composed of three benches rising above Savenac Creek. The bench on which the main seedbed area and building are located contains $1\frac{1}{2}$ acres, the second bench, also planted in seedbeds, contains $\frac{3}{4}$ acres, and the third bench, lying about 48 feet above the first bench devoted to transplants, seedbeds, truck garden and hay land, contains $25\frac{1}{4}$ acres---total of $27\frac{1}{2}$ acres. The total area is cleared and under cultivation.

Transportation facilities for the nursery are ideal. The "Yellowstone Trail"---northern highway---passes through Savenac; all trains stop at Haugan on the Chicago, Milwaukee & St. Paul Railroad, one-half mile from the nursery; and all trains may be flagged at Wence Spur, on the Northern Pacific Railroad, less than one-fourth mile from the nursery.

REFERENCE

In a "Report on Nursery Site" dated July 20, 1909, E. O. Clifford described the location, area, soil, water, etc., of the site which he recommended to be known as the "Savanna Nursery." It is located on the Savanna Administrative Site, Hangan, Montana, in Section 22, T. 19 N., R. 30 W., M. 1. N., at an elevation of 3,150 feet. The nursery area is composed of three benches rising above Savanna Creek. The bench on which the main seeded area and building are located contains 1 1/2 acres, the second bench, also planted in seedbeds, contains 1/2 acres, and the third bench, lying about 48 feet above the first bench devoted to transplants, seedbeds, truck garden and hay land, contains 2 1/2 acres--total of 4 1/4 acres. The total area is cleared and under cultivation. Transportation facilities for the nursery are ideal. The "Yellowstone Trail"--northern highway--passes through Savanna; all trains stop at Hangan on the Chicago, Milwaukee & St. Paul Railroad, one-half mile from the nursery; and all trains may be flagged at Wence Spur, on the Northern Pacific Railroad, less than one-fourth mile from the nursery.

Starting in the fall of 1909, a mushroom-like growth of the Savenac Nursery continued until by the fall of 1912 it was the largest in the Service. This growth is due to two things: first, to the fact that it is ideally situated for supplying stock to the entire western part of the District; and second, to the fact that during that period a complete change in the reforestation policy of the District took place, resulting in the determination to put practically all of the money available for the work in this District, into the white pine region..

Mr. Clifford proposed a capacity of 1,000,000 seedlings. In a report dated August 3, 1909, he outlined the capacity at 1,500,000 as follows:

Western white pine	500 M.
Western yellow pine	500 M.
Douglas fir	250 M.
Engelmann spruce	250 M.

The actual construction work started under G. B. McDonald in September, 1909, when 50 shade frames were partially completed, the water system nearly completed, ($\frac{1}{2}$ mile of ditch being constructed and 510 feet of one-inch pipe on the ground) and 3 acres cleared and plowed, with 3 acres partially cleared.

The first sowing was done on June 8-10, 1910, as follows:

W. white pine	45.00%
Y. white pine	22.50%
W. larch	1.20%
Engelmann spruce	.70%
W. red cedar	.20%
W. white pine	.20%
Total	102.00%

Although authorized at a capacity of 3,750,000,

Starting in the fall of 1909, a warehouse-

like growth of the Savenac Nursery continued until
by the fall of 1912 it was the largest in the Service.
This growth is due to two things: first, to the fact
that it is ideally situated for supplying stock to the
entire western part of the District; and second, to the
fact that during that period a complete change in the
reforestation policy of the District took place,
resulting in the determination to put practically all
of the money available for the work in this District
into the white pine region.

Mr. Clifton proposed a capacity of 1,000,000
seedlings. In a report dated August 2, 1909, he outlined
the capacity at 1,500,000 as follows:

Western white pine	500 M.
Western yellow pine	500 M.
Ponderosa pine	500 M.
Engelmann spruce	500 M.

The actual construction work started under
G. B. McDonald in September, 1909, when 50 shade frames
were partially completed, the water system nearly
completed, (1/2 mile of ditch being constructed and
210 feet of one-inch pipe on the ground) and 3 acres
cleared and plowed, with 2 acres partially cleared.
The first seeding was done on June 8-10, 1910,
as follows:

<u>Species.</u>	<u>M.</u>	<u>Lbs. Seed per 12' Bed.</u>
W. yellow pine	519.12	3.5
Engelmann spruce	331.60	.75
Douglas fir	182.90	3.0
W. white pine	15.70	5.0
W. larch	13.00	3.0
E. white pine	5.80	5.0
Sugar pine	.30	---

Total---1,068.42

It was aimed to get 10,000 seedlings per bed in Western yellow pine and Western white pine.

A total of 10,150 Eastern white pine and Western yellow pine seedlings were transplanted in the spring of 1910 at a cost of \$2.75 per M.

The fires of 1910 killed all of the Western yellow pine transplants and most of the Western white pine, the seedbeds being uninjured. All buildings then on the site were wiped out.

The stock from the St. Regis Nursery was gradually disposed of by shipment to the field or to Savenac, and the former nursery was abandoned in 1912.

In the spring of 1912 the capacity of Savenac Nursery, as authorized by the Washington Office, was 3,500,000, this being raised the following spring to 3,750,000 with the stock grown, proportioned as follows:

W. white pine-----	75.00%
W. yellow pine-----	22.50%
W. larch-----	1.20%
Engelmann spruce-----	.70%
W. red cedar-----	.30%
E. white pine-----	.30%

Total---100.00%

Although authorized at a capacity of 3,750,000,

Box Seed per 12' Seed

Box

Species

5.5	219.12	W. yellow pine
7.5	321.60	Engelmann spruce
8.0	182.90	Douglas fir
8.0	18.70	W. white pine
8.0	13.00	W. larch
8.0	8.80	E. white pine
---	.30	Sugar pine

Total---1,068.48

It was aimed to get 10,000 seedlings per box in Eastern yellow pine and Western white pine. A total of 10,180 Eastern white pine and Western yellow pine seedlings were transplanted in the spring of 1910 at a cost of \$2.75 per M. The trees of 1910 killed all of the Western yellow pine transplants and most of the Western white pine, the seedlings being maintained. All buttings them on the site were wiped out.

The stock from the St. Regis Nursery was gradually disposed of by shipment to the field or to Savanac, and the former nursery was abandoned in 1912. In the spring of 1912 the capacity of Savanac Nursery, as authorized by the Washington Office, was 3,500,000, this being raised the following spring to 3,750,000 with the stock grown, proportioned as follows:

75.00	W. white pine
22.50	W. yellow pine
1.20	W. larch
.70	Engelmann spruce
.30	W. red cedar
.30	E. white pine

Total---100.00

Although authorized at a capacity of 3,750,000,

the output per year never reached that. In 1914, stock shipments amounted to only 1,560,000, and in 1915 a little better than 3,000,000.

These shortages were due chiefly to losses sustained in the seedbeds the first year.

The administration of the Savenac Nursery was transferred from the Lolo Forest to the District Office in the spring of 1915, and the writer, under the direction of the District Office, was placed in charge. This transfer was made "because of the increasing amount of specialized work involved in nursery practice, which should not properly tax the attention of a busy Supervisor, since the nursery is not essentially a part of the Forest organization."

With the assistance of Supervisor Koch and the rangers formerly employed at the nursery, it has been possible to advance the work with little or no lost motion resulting from the change, although it has, of course, been necessary for the writer to spend a great deal of time in the study of details this year, which will be unnecessary in the future. With these details now in hand, and the ditch and building improvements complete, opportunity will be afforded in another year to concentrate on numerous mechanical and administrative improvements which it has been previously impossible to consider, for lack of time.

A summary of the total expenditure of Planting

the output per year never reached that. In 1914, stock
shipments amounted to only 1,580,000, and in 1915 a little
better than 2,000,000.

These shortages were due chiefly to losses

sustained in the seedbed the first year.

The administration of the Nevada Bureau was

of the District Office, was placed in charge. This in the spring of 1918, and the writer, under the direction transferred from the Lolo Forest to the District Office

the nursery is not essentially a part of the forest organ-
ization. It is not properly the attention of a forey supervisor, since
specialized work involved in nursery practice, which shall
thereafter be made "because of the increasing amount of

lack of time. which it has been previously impossible to consider, for on numerous mechanical and administrative improvements opportunity will be afforded in another year to concentrate, and the detail and building improvements complete, be unnecessary in the future. With these details now in detail of time in the study of details this year, which will course, been necessary for the writer to spend a great motion resulting from the change, although it has, of possible to advance the work with little or no loss. workers formerly employed at the nursery, it has been With the assistance of Superintendent Lash and the

money for each Fiscal Year follows:

Fiscal year 1910 - - - \$2,116.81

Fiscal year 1911 - - - \$1,492.32 square feet of

seed Fiscal year 1912 - - - \$6,897.73 nursery.

Included Fiscal year 1913 - - - \$8,244.87 total area is

130,000 Fiscal year 1914 - - - \$6,093.61 When germination

is complete Fiscal year 1915 - - - \$5,752.71 be approximately

A considerable amount for ranger and guard labor was

also expended up to the Fiscal Year 1915. for seedbeds

and 2 acres The amounts expended annually vary with the

need for permanent improvements and the amount of stock

to be sowed or transplanted to reach the authorized

capacity. is 4,000,000. Providing all stock shipped

to the field were 3 year old transplants, an annual

capacity of 4,000,000 would take up all available ground

for trees, but since a large amount of seedling stock is

shipped--at present about fifty per cent--single ground

is left for rotation of crops and summer fallowing.

There is also extra ground for the nursery truck garden,

and several acres of hay land. In the Fiscal Year 1917

the annual capacity will have reached 4,000,000.

Money for each Fiscal Year follows:

Fiscal year 1910	- - - -	\$2,116.81
Fiscal year 1911	- - - -	\$2,482.22
Fiscal year 1912	- - - -	\$2,827.75
Fiscal year 1913	- - - -	\$2,844.97
Fiscal year 1914	- - - -	\$2,993.61
Fiscal year 1915	- - - -	\$2,722.71

A considerable amount for wages and guard labor was

also expended up to the Fiscal Year 1915.

The amount expended annually with the

need for permanent improvements and the amount of stock

to be owned or transferred to reach the authorized

capacity.

CAPACITY.

At present there are 79,632 square feet of seed beds, or 1659 - 4' x 12' beds in the nursery. Including paths and odd corners the total area is 130,000 square feet, or about 3 acres. When germination is complete in all beds, the stand will be approximately 6,860,416. There are 1718 transplants in the field, covering about 5 acres. Allowing 3 acres for seedbeds and 2 acres for roads and ditches, leaves $22\frac{1}{2}$ acres available for transplants. Transplants are left in the bed 2 years, so at 350,000 per acre, the transplant capacity is 4,000,000. Providing all stock shipped to the field were 2 year old transplants, an annual capacity of 4,000,000 would take up all available ground for trees, but since a large amount of seedling stock is shipped--at present about fifty per cent--ample ground is left for rotation of crops and summer fallowing. There is also extra ground for the nursery truck garden, and several acres of hay land. In the Fiscal Year 1917 the annual capacity will have reached 4,000,000.

sediment carried down by the water. The water is then
pipe tops the bottom of the pipe is 4 inches in diameter
4-inch main which carries the water to the nursery. The
to the nursery. The water is then carried to the nursery
24-inch main for supplying water to the nursery.

CAPACITY.

At present there are 75,632 square feet of seed beds, or 1650 - 4' x 12' beds in the nursery. Including paths and 500 corners the total area is 130,000 square feet, or about 3 acres. When germination is complete in all beds, the stand will be approximately 6,860,416. There are 1718 transplants in the field, covering about 5 acres. Allowing 3 acres for seedbeds and 2 acres for roads and ditches, leaves 23 1/2 acres available for transplants. Transplants are left in the bed 2 years, so at 350,000 per acre, the transplant capacity is 4,000,000. Providing all stock shipped to the field were 2 year old transplants, an annual capacity of 4,000,000 would take up all available ground for trees, but since a large amount of seedling stock is shipped--at present about fifty per cent--ample ground is left for rotation of crops and summer fallowing. There is also extra ground for the nursery truck garden, and several acres of hay land. In the Fiscal Year 1917 the annual capacity will have reached 4,000,000.

The seed beds on the third bench are watered from the
WATER SYSTEMS.
ditch at that point, but when moved to the lower end
of that bench.

The Government has secured first water right on Savenac Creek. Four hundred and thirty-two miners' inches have been filed on. This amount is about the full flow of water in the creek during the dry summer season.

At present there is approximately one and one-half miles of ditch in use, nearly a mile of the old ditches having been abandoned, due to low pressure and insufficient volume of water obtained, and a new water system installed. The new system, mostly a mud-puddled ditch carried on the side hill, but flumed over the rocky points and slumping places with two-inch plank, is taken from the creek a little better than a mile from the nursery. It has a fall of six feet, resulting in an elevation of 104 feet at the settling box above the lowest seed bed area. This elevation gives a pressure of 45 pounds on the first bench. The settling box, holding 425 gallons, is not used as a reservoir, but serves as a means of straining and settling foreign matter and sediment carried down by the water. A 5-inch intake pipe taps the settling box at the bottom, and feeds the 4-inch main which extends through the main seed bed area to the nursery street. This 4-inch main sends out a 2½-inch main for supplying water on the middle bench.

WATER SYSTEMS.

The Government has secured first water right on Savanna Creek. Four hundred and thirty-two miners' inches have been filed on. This amount is about the full flow of water in the creek during the dry summer season.

At present there is approximately one and one-

half miles of ditch in use, nearly a mile of the old ditches having been abandoned, due to low pressure and insufficient volume of water obtained, and a new water system installed. The new system, mostly a run-gabled ditch carried on the side hill, but flumed over the rocky points and alighting places with two-inch flume, is taken from the creek a little better than a mile from the nursery. It has a fall of six feet, resulting in an elevation of 104 feet at the settling box above the lowest seed bed area. This elevation gives a pressure of 45 pounds on the first bench. The settling box, holding 455 gallons, is not used as a reservoir, but serves as a means of straining and settling foreign matter and sediment carried down by the water. A 6-inch intake pipe taps the settling box at the bottom, and feeds the 4-inch main which extends through the main seed bed area to the nursery street. This 4-inch main sends out a 2 1/2-inch main for supplying water on the middle bench.

The seed beds on the third bench are watered from the ditch at that point, but when moved to the lower end of that bench the settling box can feed another main for these beds. There is sufficient volume flowing into the settling box to supply at least two 4-inch mains. The overflow is conducted down the face of the slope in a flume.

The laterals are all 1-inch pipe. The hose bibbs are so placed that with a 50-foot hose connection, the entire area can be easily covered. The ordinary solid round lawn sprinklers are used in watering the beds. The 4-inch main will keep thirty of these sprinklers at once, but for light sprinkling this would necessitate quite a crew of men to handle the sprinkling. Eleven sprinklers are all that one man can handle.

The overhead sprinkling systems were investigated and worked on this summer. No commercial system was found that would suit our needs, so one of our make was experimented with: 3/32-inch holes are drilled in alternating distances of 4 and 8 feet apart. Between the 8-foot aperture a hole 1/16 of an inch is drilled and hooded with a metal cap that spreads the stream into a fan-shaped spray. These sprays cover the first eight feet of seed beds, and the beds beyond that are sprinkled by the unobstructed streams. With our pressure, the water

The seed beds on the third bench are watered from the ditch at that point, but when moved to the lower end of that bench the settling-box can feed another main for these beds. There is sufficient volume flowing into the settling box to supply at least two 4-inch mains. The overflow is conducted down the face of the slope in a flume.

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The overhead sprinkling system were investigated and worked on this manner. No commercial system was found that would suit our needs, so one of our men was experimented with: 3/32-inch holes are drilled in alternating distances of 4 and 6 feet apart. Between the 6-foot aperture a hole 1/16 of an inch is drilled and hooded with a metal cap that projects the stream into a fan-shaped spray. These sprays cover the first eight feet of seed beds, and the beds beyond that are sprinkled by the projected streams. With our pressure, the water

will cover 40 feet on each side of the pipe. As planned, these pipes will run longitudinally with the beds, fed at either end of the area by a 2-inch lateral from the 4-inch main. The perforated pipe will be reduced from $1\frac{1}{2}$ to 1 inch at the proper distance from each end, to maintain an even pressure, to the center of the area. The lateral feeds and main will be buried, to clear the surface of the ground from permanent piping, and the spraying pipes raised on 1-foot posts, so the streams will clear the seedlings, and keep the perforations from becoming clogged by being trampled on. A sprinkling system of this kind will lessen costs considerably, for while one man is kept constantly at work watering the trees under the present system, under the overhead all that is needed is the turning on of the taps in the evening, and letting them run until the seedlings have received sufficient moisture. This will also enable us to sprinkle in the cool of the evening, instead of in the hot sun, which, although it has not been proven by experiments to have an ill effect, theoretically is injurious to the young growth.

At the lower end of the 4-inch main, are attached two 2-inch gate-valve taps. A few feet from these is a large reel containing 300 feet of 2-inch mill hose in 50-foot lengths, set in a hose house that can be turned about on a swivel and unreeled in any direction and coupled to

will cover 40 feet on each side of the pipe.

As planned, these pipes will run longitudinally

with the beds, laid at either end of the area by a 2-inch

lateral from the 4-inch main. The perforated pipe will

be reduced from 1 1/2 to 1 inch at the proper distance from

each end, to maintain an even pressure, to the center of

the area. The lateral feeds and main will be buried, to

clear the surface of the ground from permanent piping, and

the spraying pipes raised on 1-foot posts, so the streams

will clear the seedlings, and keep the perforations from

becoming clogged by being trampled on.

A sprinkling system of this kind will lessen

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proven by experiments to have an ill effect, theoretically

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At the lower end of the 4-inch main, are attached

two 2-inch gate-valve taps. A few feet from these is a

large reel containing 500 feet of 2-inch mill hose in 50-

foot lengths, set in a hose house that can be turned about

on a swivel and unreeled in any direction and coupled to

the taps. These 300 feet of hose will allow a play of two streams on all nursery buildings except the barn, and one stream on the two remote ranger dwellings.

The domestic system is furnished with water from the 4-inch main also, but since the water must be shut down in winter, and is often undesirable, due to standing in the pipes during the hot day, it is recommended that a small ram be installed for domestic purposes.

The transplant area is watered by irrigation. The system is not elaborate, since the upper bench has an even, gradual slope, and the location of ditches is apt to change as different arrangements of the transplants require.

more of seed beds will cause no crowding of the land, yet it will necessitate getting out a large number of new beds on the third bench, which has several disadvantages, namely: less water pressure; more weeds, and distance from the center of material and equipment. However, if we continue to grow mostly seedling stock, arrangements can be made for a more systematic handling of the beds on the upper bench. The volume of water in the high ditch will be sufficient, but additional mains and settling boxes will have to be installed to supply what lacks in pressure on the third bench from the

the tanks. These 300 feet of hose will allow a play of
two streams on all nursery buildings except the barn,
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NURSERY PRACTICE.

Seedlings.

Seedling stock will have to be depended upon to raise the capacity to 4,000,000 in the Fiscal Year 1917, and to maintain it for two years. Most of the stock originally sown for transplanting that does not appear too dense in the beds, will lie over next year, and then be shipped as seedling stock. (See Capacity Schedule). Adding the area necessary for spring planting, exclusive of beds that will be taken up in the spring and resowed, a total of four acres will be needed for the seedling stand next year. While this additional acre of seed beds will cause no crowding of the land, yet it will necessitate putting out a large number of new beds on the third bench, which has several disadvantages, namely: Loss water pressure; more weeds, and distance from the center of material and equipment. However, if we continue to grow mostly seedling stock, arrangements can be made for a more systematic handling of the beds on the upper bench. The volume of water in the high ditch will be sufficient, but additional mains and settling boxes will have to be installed to supply what lacks in pressure on the third bench from the

SEEDLING PLANTING

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present main. The weeds will, of course, eventually be reduced to a minimum, and all beds on the third bench can be moved to the lower end, thus bringing them adjacent to the other seed bed areas.

1. Preparation.

In grouping the beds, consideration is given first to the time the stock is to be taken out. For example, we have one hundred spruce beds on one corner of the area which will be shipped in the spring. Alongside these are two hundred beds of 1-0 yellow pine, which will be shipped the following year as 2-0 seedlings. Yellow pine which is to be transplanted when one year old is planted in the old spruce plot, so that the two plots of yellow pine will come out at the same time. This will enable more ground to be plowed than if these two plots were separated by stocked seed beds, and in many cases, make it possible to cross plow the area, which is very beneficial to the physical improvement of the soil. Also, material and equipment, such as seed, sand and tools for resowing this area, need not be distributed between the two areas.

Second, consideration in grouping. Attention is given to the similarity of care and treatment of the stock. For example, in sowing the spruce, we find it has two alternatives under the first consideration, Eastern and Western white pine. It is sowed in a plot

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Eastern and Western white pine. It is sowed in a plot

adjoining the Western white pine, because both require shading during the summer, and thus the two plots may be handled as one. A few odd beds above or below the Capacity Schedule requirements are omitted or left blank. All new experimental beds will be put in the new experimental area on the third bench, so as not to interfere with a systematic arrangement of the beds.

----- From
Dead Beds. Transplant Area.
Sample No. I. II.
After plowing, the ground is thoroughly harrowed with a spring-tooth harrow, and, if necessary, further levelled and pulverized with a float. The beds are then marked off with string, four feet wide and forty-eight feet long, with two-foot paths between. When commercial fertilizer is used, it is applied at this stage of the bed-making. It is applied by hand, and then worked into the soil with rakes. When horse-manure is used, it is worked into the ground by the first plowing. The beds are raised slightly by shoveling dirt from the paths, then carefully raked and levelled by hand. During this last operation, stones, roots, sod and hard lumps of dirt are scraped back into the path and later wheeled away. A final smoothing of the bed is done with a board about two feet long, manipulated on edge with one hand, to pulverize all lumps of dirt and make the surface free from small cavities that seed are apt to drop into.

2. Fertilizers.

The most suitable fertilizer for forest nurseries is a question of the greatest importance.

Analysis of two samples of soil from Severac Nursery, made by the Bureau of Soils in 1913, shows the following results:

Severac Nursery.

Sample No.	From Seed Beds.	From Transplant Area.
I.	II.	
For cent 0.0	.28	.24
" " P_2O_5	.18	.30
" " K_2O	.21	.24
" " "	.09	.14

Up to 1914, horse manure was used at Severac

Nursery with satisfactory results as far as a more luxuriant growth of the stock was concerned, but manure brought a large amount of grass-weed into the beds. Applications of lime, bone meal, and swamp mud were tried, but there was no apparent difference between the fertilized and the check beds. From the results obtained with horse manure, it was believed that the soil lacked sufficient nitrogen. In 1914 a dressing of dried blood and bone meal was tried. A report of that year states: "The use of fertilizer (blood and bone) has made a tremendous

difference in the thrift and uniformity of the stock." For a while, an application for the chemical improvement of the soil seemed quite solved, but this year complications have set in. All spring sown beds were given a dressing of two pounds dry blood and one pound bone meal, to forty-eight square feet. Beds were left to check the results. In general, the fertilized stock has a rich, dark color, and appears more thrifty than the yellow-green spindly, non-fertilized stock. On close examination, the crown is found to be larger in the treated beds. Of the 107 beds sowed for yellow pine transplant stock, the four check beds have the thickest stand. This, however, may have no bearing on the fertilizer. This summer, the white pine beds were infected with a disease termed "Purple Top" by the Consulting Forest Pathologist of this District. All of this area, excepting one row of experimental beds lying adjacent, had been dressed with blood and bone meal when sowed. as far as we have been able to ascertain, the fertilizer in the main block of stock, and not in the experimental beds, was the only difference in the care and treatment between the two. Yet, while the experimental row had only one dead tree at the most per forty-eight square feet, due to the "Purple Top" disease, the beds adjacent were literally brown with dead seedlings. This fact, and

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 were literally brown with dead seedlings. This fact, and

the fact that detailed notes in comparison between the fertilized and non-fertilized stock set out on experimental plantations, showed less survival (although greater average growth in the fertilized stock) led me to believe that this commercial fertilizer predisposes the stock to fungous attacks. Most authorities on the subject will agree that, in order to obtain the best results from nursery stock planted in the field, it must be grown in as near like condition at the nursery as nature would have it propagated under its parent tree. Yet we are coaxing along the stock with a stimulus, as the grower does the hothouse rose, resulting in a weakened plant organism, and expect it to better survive all competition in the field than stock trained for field planting. Data on these two classes of stock planted in the field is little, but it is hoped more will be obtained so that we can draw definite conclusions. What may give satisfying results in the nursery end of forest extension may have its ill-effect in the field. It is survival in the field that we want, and the cost of tree production at the nursery is, in many cases, less than the cost of actually setting the trees in the plantation.

An elaborate set of checks on blood and bone meal fertilizer was started this fall at the nursery. This stock will be watched closely in the field, from which,

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Amount of Seed to Sow per 12-foot Bed.
 it it believed, conclusive results can be obtained, to
 ascertain just what effect the commercial fertilizer has
 on the planted trees. Experiments with other fertilizers
 will be renewed in the spring.

3. Sowing.

All coniferous seed is sowed broadcast. The
 desired amount of seed for forty-eight square feet is
 weighed in a postal scale, and placed in pails set 12 feet
 apart in the row of beds. This unit will help to more
 accurately gauge even sowing than if the sower had to handle
 large quantities of seed for larger areas.

The sower walks down one side of the row of beds,
 casting the seed from the path to the center in quarter-circ-
 lar sweeps. He does not hop over the row and finish the
 twelve-foot bed before he starts sowing another, but sets
 down the pail and picks up the next, and so on, until the
 of beds is finished on the one side, then comes up on the
 other. The foreman generally weighs and sows the seed.

Following is a table showing amount of seed sowed
 per forty-eight square feet in 1915:

<i>P. monticola</i>	252-0
<i>P. strobus</i>	253-0
<i>Picea Engelmanni</i>	5-0
<i>P. ponderosa</i>	2-0

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Following is a table showing amount of seed sowed per forty-eight square feet in 1915:

Amount of Seed to Sow per 12-foot Bed.						
Species	Seed per Pound	Exp. Sta.: Germ. Test	Class of Stock	Amount Sown	Expected Stand	
P. monticola	25,197	45%	Seedling	10 ozs.	7,500	
			Transplant	1 lb.	12,000	
P. strobus	29,274	60%	Seedling	7 ozs.	7,500	
			Transplant	1- $\frac{1}{4}$ lb. *)	14,000	
Picea Engel- mami	140,500	83%	Seedling	.6 ozs.	4,500	
			Transplant	1.7 "	12,000	
P. ponderosa	-old seed -		Seedling	17 "	3,000	
			Transplant	2- $\frac{3}{8}$ lb.	6,500	

*) Relatively large. Not to be left in the beds for the second year germination.

Age of Seedling Stock When Transplanted.	
Species	Age
P. monticola	1&2-0
P. strobus	1-0 - (When large per cent of germination holds over 1&2-0.)
Picea Engelmanni	2-0
P. ponderosa	1-0

Age of Seedling Stock When Shipped.	
Species	Age
P. monticola	2&3-0
P. strobus	2&3-0
Picea Engelmanni	3-0
P. ponderosa	2-0

Species	Per cent of Stock	Seedling	Transplant	Amount of Seed to Sow per 10-foot Bed
<i>P. monticola</i>	25, 15%	45%	10 oars, 1 lb.	7,500
<i>P. atropus</i>	22, 3%	60%	7 oars, 1 lb.	12,000
<i>Picea Engelmannii</i>	140, 500	85%	6 oars, 1 lb.	7,500
<i>P. ponderosa</i>	- old seed	-	1 lb.	12,000

*) Relatively large. Not to be left in the beds for the second year germination.

Species	Age
<i>P. monticola</i>	12-0
<i>P. atropus</i>	1-0 - (When large per cent of germination holds over 12-0)
<i>Picea Engelmannii</i>	2-0
<i>P. ponderosa</i>	1-0

Species	Age
<i>P. monticola</i>	22-0
<i>P. atropus</i>	22-0
<i>Picea Engelmannii</i>	3-0
<i>P. ponderosa</i>	2-0

The ideal amount of stock to grow per bed is being worked out in nursery experiments. Pending final conclusions, densities shown in table on page 18 are representative, in my best judgment, of the amount to sow per forty-eight square feet.

After sowing, the seed is covered with fine river sand. The sand is carted along the paths in wheelbarrows and distributed as evenly as possible with a shovel. It is then levelled off with a straight-edged board about two feet long, manipulated by one man, very much the same as in levelling the surface of a newly laid cement walk. Formerly the sand was firmly packed with a tamper, but this fall a water-weighted roller, fifty-two inches wide, was tried out, which not only reduced the cost of the operation many hundred per cent, but also packed the sand more uniformly. It is necessary for our light soil, that this roller be at least two feet in diameter, to avoid a rippling effect on the surface of the beds.

4. Depth of Covering.

Numerous experiments at the nursery show that the depth of sand cover is vital to the germination of the seed. In the table following are some of the results obtained from experiments of the depth of sand cover. It is believed that uneven density in the beds is due more to uneven depth of covering than to uneven sowing. Just what covering will give best results can be determined only by experiments.

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Four beds at Savenac Nursery were sown to determine the proper depth of cover, in May, 1914, two broadcasted and two in drills. Each bed contained plots of Western white pine seed covered with 1/4", 3/8", 1/2", 5/8", and 3/4" of sand. Each plot was sown with a uniform quantity of seed.

Current records were made from time of sowing until August 1, 1915, when germination was complete, and the season's loss appeared likewise to have taken place. Survival counts August 1, 1915, gave these results:

Depth of Cover.						No. of Plots Ave. is Based on
Method	1/4"	3/8"	1/2"	5/8"	3/4"	
Ave. Drills	379	309	206	166	107	2
Ave. Broadcast	610	544	363	243	175	2
Ave. Both	494	426	284	204	141	4
Per cent of No. surviving at 1/4"	100%	86.2%	57.5%	41.3%	28.5%	4

The total recorded damping-off loss up to August 1, 1915, was:

Method	1/4"	3/8"	1/2"	5/8"	3/4"	No. of Plots Ave. is Based on
Average both methods	186	176	187	184	192	4
Per cent of total germination lost through damping off	25.7%	26.9%	37.0%	45.0%	55.7%	4

Four beds at Sevenside Nursery were sown to

determine the proper depth of cover. In May, 1916, two
 processed and two in drills. Each bed contained plots
 of Western white pine seed covered with $1\frac{1}{4}$ ", $3\frac{1}{8}$ ", $1\frac{1}{2}$ ",
 $5\frac{1}{8}$ ", and $2\frac{1}{4}$ " of sand. Each plot was sown with a uniform
 quantity of seed.

Current records were made from time of sowing
 until August 1, 1916, when germination was complete, and
 the season's loss appeared likewise to have taken place.
 Survival counts August 1, 1916, gave these results:

Depth of Cover.					
Method	$1\frac{1}{4}$ "	$3\frac{1}{8}$ "	$1\frac{1}{2}$ "	$5\frac{1}{8}$ "	$2\frac{1}{4}$ "
Ave. Drills	279	302	306	166	107
Ave. Broadcast	210	244	303	243	178
Ave. Both	434	483	384	204	141
Per cent of No.					
Surviving at 1916	100%	88.2%	87.5%	41.3%	28.5%

The total recorded damping-off loss up to

August 1, 1916, was:

Method					
Method	$1\frac{1}{4}$ "	$3\frac{1}{8}$ "	$1\frac{1}{2}$ "	$5\frac{1}{8}$ "	$2\frac{1}{4}$ "
Average both	136	176	187	164	132
Per cent of					
total germina-					
tion lost					
through damp-					
ing off	25.7%	26.2%	27.0%	45.0%	55.7%

From the data obtained, it is concluded that:

1. One-fourth inch is the optimum depth for sand cover on Western white pine beds, combining:

- (a) highest rate of germination,
- (b) lowest relative loss from a uniform density damping-off, and from all depths of cover, no matter how great, may be distributed over the sowing surface,
- (c) highest relative survival.

2. Under the conditions of this test, one pound of seed will produce as many plants under 1/4" cover, as 1-1/7 pounds under 3/8" cover, or nearly twice as many as 2 pounds at 1/2" in depth.

3. Absolute prevention of damping-off, while it would be relatively advantageous to the deeper sown seed, would not prevent a heavy waste with deep cover. The theoretical survival, had there been no loss from damping-off, would stand thus:

	(Actual)		(Average Loss)		(Average)
	(Average)	-	(from)	=	(Theoretical)
	(Survival)		(Damping-off)		(Survival)
					(Damping-off)
					(Eliminated)
1/4"	494	-	186	=	680
3/8"	426	-	176	=	602
1/2"	284	-	187	=	471
5/8"	204	-	184	=	388
3/4"	141	-	192	=	333

from the data obtained, it is concluded that:

1. One-fourth inch is the optimum depth for

seed cover on Western white pine beds, combining:

(a) highest rate of germination,

(b) lowest relative loss from

damping-off, and from all

causes combined,

(c) highest relative survival.

2. Under the conditions of this test, one

ounce of seed will produce as many plants under $1/4$ "

cover, as $1-1\frac{1}{2}$ pounds under $3/8$ " cover, or nearly

2 pounds at $1/2$ " in depth.

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growing seed, would not prevent a heavy waste

with deep cover. The theoretical survival, had

there been no loss from damping-off, would stand thus:

(Average (Theoretical (Survival (Damping-off (Eliminated)	=	(Average loss (from (Damping-off)	-	(Actual (Average (Survival)	
880	=	186	-	484	$1/4$ "
602	=	176	-	426	$3/8$ "
471	=	167	-	304	$1/2$ "
388	=	164	-	204	$3/4$ "
333	=	152	-	181	1 "

4. The economy in both cover material and labor with 1/4" sand cover is apparent.

5. It appears, however, that shallow covering is likewise more favorable to weed-growth.

6. It is impossible to obtain a uniform density with this species without uniformity in depth of cover, no matter how evenly the seed may be distributed over the sowing surface.

The seed contains chiefly food stored up for the use of its embryo, as soon as germination sets in. No food is manufactured by the young plant until it pierces the surface of the soil, when the light enables the plant to carry on photosynthesis. Therefore, if the sand covering is of such depth that the embryo has used up this stored food, it will die of starvation, as it were. It might be pointed out here, that when we speak of those above the ground as representing germination, we are partially in error, for many may have died after germination, but before they reached the surface.

Means and devices for securing a uniform depth over the beds have been worked on, but up to the present time, with no satisfying results. Since the surface of an individual bed may be curved or rolling, a frame for gauging the cover cannot be set economically to conform to these irregularities of the surface.

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an individual bed may be curved or rolling, a frame for

gauging the cover cannot be set economically to conform

to these irregularities of the surface.

Until a means for regulating this depth of cover has been solved, the old method of just guessing will have to be followed, although the irregularities may be somewhat modified by more painstaking in the operation.

5. Acid Treatment.

Within twenty-four hours after sowing, all beds, excepting those left to check results, are given the sulphuric acid treatment recommended by Carl Hartley--- 3/16 fluid ounces of acid, diluted in 3/16 gallons of water, applied to the square foot. Two days after the acid treatment, the beds are given a thorough sprinkling to wash the fungicide well down in the soil.

We are having difficulty in securing a sprinkling can that will not be eaten by the acid so rapidly. The one we are using will last about four hours of continuous use, and then must be replaced with another. The rest of the can remains intact with this usage, but must be abandoned because of the eaten spout. A paraffin coating on the can has been tried, but it does not check the reaction of the acid on the zinc enough to warrant this extra precaution. Attempts will be made to secure sprinklers made of granite ware, glass or wood, for applying the acid.

The acid is bought in carboys, at a price ranging from 4 cents to 5 cents per pound. It is believed that this cost can be reduced to about 2 cents by purchasing it in large drums containing about 1,000 pounds. All acid is

Until a means for regulating this depth of cover has been solved, the old method of just guessing will have to be followed, although the irregularities may be somewhat modified by more painstaking in the operation.

5. Acid Treatment.

Within twenty-four hours after sowing, all beds, excepting those left to check results, are given the sulphuric acid treatment recommended by Carl Hartley-- $2\frac{1}{2}$ fluid ounces of acid, diluted in $2\frac{1}{2}$ gallons of water, applied to the square foot. Two days after the acid treatment, the beds are given a thorough sprinkling to wash the fungicide well down in the soil.

We are having difficulty in securing a sprinkling can that will not be clogged by the acid so rapidly. The rose will last about four hours of continuous use, and then must be replaced with another. The rest of the can remains intact with this usage, but must be abandoned because of the rotten growth. A paraffin coating on the can has been tried, but it does not check the reaction of the acid on the same enough to warrant this extra precaution. Attempts will be made to secure sprinklers made of granite ware, glass or wood, for applying the acid.

The acid is bought in carboys, at a price ranging from 4 cents to 5 cents per pound. It is believed that this cost can be reduced to about 2 cents by purchasing it in large drums containing about 1,000 pounds. All acid is

purchased at commercial strength, 93.50% - specific gravity, 1.835, - 66 degrees Beaume, but since it may weaken through handling, or lying over to the next sowing, I recommend that a hydrometer be used for testing the strength of the acid before it is applied, in order that we may accurately check results.

6. Season of Sowing.

For the fine seeded specimens, such as larch and spruce, spring sowing is entirely satisfactory, and we have had no trouble with seed holding over for a year. The sowing, however, should be done early, provided the ground is dry enough to work well, usually about the latter part of April. This applies to all species for spring sowing. Yellow pine has been sown in the spring, but this seed is showing a tendency to partly hold over its germination until the last month or two of the growing season. This late germination in transplant stock is not noticeable, although it may have its ill effect in winter killing or the shock sustained by transplanting, but in raising 2-0 stock, the seedlings of fall germination are so inferior that it is necessary to cull them out when the stock is taken up. About 25% of the 2-0 yellow pine stock taken up this fall was discarded for this reason. Fall sowed experimental beds of this class of stock, show thrifty stock of even age.

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Fall sowed experimental beds of this class of stock, show

thirty stock of even age.

The question of germinating Western white pine in one year has not been solved. Early fall sowing of this species is practised.

Eastern white pine seems to vary in its tendency to all germinate the first year. While total germination the first year can generally be depended upon if the seed are soaked in water several days before sowing, still, seed from a different lot may hold over as in Western white pine. Seed purchased from the Northeast Forestry Company all germinated the first year. Seed from Meehan & Sons, treated exactly like the other lot here at the nursery, held about 50% of its germination over to the second year. It is believed that this irregularity can be avoided by fall sowing of Eastern white pine.

The sowing and care of the seed beds are under direct supervision of Assistant Forest Ranger W. F. Simons, who has spent four years at the nursery, and is a thoroughly competent man. He is given work six months out of the year and a government house at the nursery, where he resides the year round. If possible, he should be transferred to a small nursery, on which there is work for him year-long.

The following is a good unit working crew for actual sowing and covering of the seed beds:

- 2 men to wheel and spread sand,
- 1 man (foreman) to weigh and sow seed,
- 2 men to level off sand and roll beds.

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2 men to wheel and spread sand,
1 man (foreman) to weigh and sow seed,
2 men to level off sand and roll beds.

This crew of five men can sow and cover 200 12-foot beds per day. The same crew can prepare for sowing, 150 beds per day.

7. Shading.

Both the nursery experiments and general practice in the nursery have shown conclusively that shade is unnecessary for yellow pine, but advantageous for Western white pine, cedar and spruce. Western white pine and spruce are given one-half shade, and cedar, three fourths. Since the twelve-foot bed has been abandoned and the longer beds substituted, it will be more convenient and cheaper to use woven lath that can be rolled up, than the present 4 x 12 shade frames.

More care should be exercised in placing, and particularly in removing artificial shade. I believe that considerable loss is sustained from sun scorch by removing the shade from the seedlings on a bright day. By selecting a cloudy day for this, or removing the shade for only a few hours at a time - in the morning - to gradually accustom the trees to full light, loss from this cause will be reduced.

8. Cultivation and Weeding.

No cultivation is advisable for broadcast beds. Weeding should be a continuous operation, and the beds kept clean. The thicker and more uniform the seedling stand, the less weeding will be required. All weeding in the beds is done by hand and should be done often enough to get the weeds

This crew of five men can sow and cover 200 12-foot beds per day. The same crew can prepare for sowing, 150 beds per day.

V. Shading.

Both the nursery experiments and general practice in the nursery have shown conclusively that shade is unnecessary for yellow pine, but advantageous for Western white pine, cedar and spruce. Western white pine and spruce are given one-half shade, and cedar, three-fourths. Since the twelve-foot bed has been abandoned and the longer beds substituted, it will be more convenient and cheaper to use woven lawn that can be rolled up, than the present 4 x 12 shade frames.

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when they are small, so as not to disturb the seedlings. An early start at the weeds will mean a great saving in this phase of the work. Last year the transplants and seedlings were neglected for several weeks during the construction of the new water-ditch. The spring, being an unusually wet one, brought out a rank abundance of weeds. As a result the weeds had the upper hand the entire season, even though five men were at work all summer, endeavoring to catch up on the weeding and the cultivation. A check on this statement is shown by the fact that I started on a block of 50 48-foot yellow pine beds as soon as weeds began to appear. This area was cleaned of all weeds in less than an hour once a week.

A special effort should be made to keep the timothy, clover and weeds along the ditches mowed down before they go to seed, as the ditches carry large amounts of seed into the nursery.

A riddance of weed and grass along the borders of the area and in the path, not only lessens the source from which foreign seed may be carried into the planted areas, but gives a clean-cut appearance to the beds and transplant rows. An edging of tall grass within a foot of the stands impresses one as a garden cut out of the jungles.

For weeding the paths in the seed beds eleven-inch, one sided sweeps of the Planet Junior hand tools were tried out this summer and found to be very satisfactory.

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9. Watering.

The amount of water applied to the seed beds, has been left largely to the judgment of the nurseryman, Simons, and I believe he has used excellent judgment. The experiments which have been made in watering have given rather inconclusive results, except that heavy watering at long intervals does not seem to be as efficient as more frequent watering.

Watering is particularly important during the germination period. It must be kept in mind that water is necessary to initiate germination. In the period following this up to the time when the sprouting of the seed actually occurs, the seed is in its most delicate condition, and most subject to serious harm or loss of entire vitality from drying out. When germinative activities are once started they should not be checked thru the lack of one of the most primary requisites, water.

Light and frequent sprinkling is given to the germinating beds, and heavier and less frequent water given to the beds that have completed germination.

10. Injuries to Seedling Stock.

Diseases: During the latter part of April, 1915, the attention of the Office of Investigations in Forest Pathology was called to a rust that had broken out on the stems of 2-0 yellow pine. Shipments to field plantations were held subject to inspection. The seedlings were found

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10. Insects to Seedling Stock.

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to be infected with the yellow blister rust, *Peridermium filamentosum*. All of the 2-0 yellow pine was inspected, and the visibly infected seedlings - about 4 per cent - culled and burned. A thorough examination of the territory surrounding the beds revealed a large patch of *Castilleja miniata* growing on the edge of a lodgepole pine stand near the creek bank, directly northeast of the infected seedling beds, and not more than 200 feet distant. The records of the weather station here show that the prevailing winds blow northeast and southwest, which is an important factor in spore distribution between the two hosts. These winds sweep northeast from the 2-0 yellow pine beds over the *Castilleja* patch, and in reversing, blow southwest from the *Castilleja* area to the seedling beds. In this manner the aeciospores from the infected yellow pine are distributed to the *Castilleja* plants and the sporidia borne on the *Castilleja* leaves are transmitted to the young trees in the beds.

The scare from the *Peridermium* infection had hardly subsided, when a seemingly more serious disease appeared on both the 2-0 yellow pine and Western white pine seedlings. The seedlings were affected with a dying of the tops or "Purple Top." The heaviest infection appeared in the beds on the west border of the grounds, where the soil conditions are the more moist, and decreased in the beds to the east, being only 15 per cent fatal in

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some of the drier beds. Investigations showed that 30 per cent of the seedlings were actually dying from this cause, and since this involved the loss of a large amount of seedlings, it became apparent that some method or methods of prevention should be introduced. The District Pathologist at this time kindly agreed to cooperate with us and the control of all nursery diseases in the District has been put under his supervision. A 4-4-50 soap Bordeaux mixture was decided upon as best serving the purpose on all the younger 1-0 seedlings, and a 5-5-50 soap Bordeaux recommended for the older and hardier seedlings. All infected plants were removed and burned. Experiments are under way to determine the exact cause of the "Purple Top" of these seedlings. be made, not only in the cost of the screens. The heavy rains of the spring caused considerable loss of Western white pine due to damping-off. I do not know whether the acid treatment of these beds, when sowed, was effective or not. No treatment was given after germination. warden to shoot these birds.

Rodents: Rodents gave us no trouble until this fall, when they attacked some of the new fall-sowed beds on the third bench. Poisoned wheat proved ineffective, but a shotgun and a few traps rid the area of chipmunks. Mice are kept down by the nursery force of cats, now numbering ten. No of part of the newly sowed area. There has not

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 ten.

Birds: Screen frames are used for protection against birds, but at no time are all germinating beds protected from them. In the past, birds have been a nuisance around the seed beds. The red poll linnets would come in large flocks and raid the newly sowed beds. When scared from one block of beds, they would fly to another. A boy was kept during most of the growing season to scare them away, but the birds could not be kept from doing considerable damage. The federal law does not permit killing the birds. This year, for some unknown reason, birds gave no trouble whatever.

Screen frames serve only as a precaution to the attacks of the birds. If these screens can be abandoned a great saving will be made, not only in the cost of the screens, but also the large amount of handling that is necessary in their use. To cover all the beds with screen would mean a total investment of \$5,000. The question would be solved if a permit could be gotten from the state game warden to shoot these birds.

Other losses: A number of two-year old pine beds were sun scorched last summer.

It is estimated that \$100 worth of damage was done to the new fall sowed white pine beds, when a stray horse got into the nursery one night, and made a race of course of part of the newly sowed area. There has not been a year in the life of the Savenac Nursery that some

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horse or cow has not gotten into the nursery and trampled down the beds. They generally gain entrance through some gate left open during the night. Self-closing gates will probably put an end to this source of damage.

(see blue print). On the card inserted in this marker for

11. Mulching.

It is clearly unnecessary to mulch yellow pine or second year white pine beds. First year white pine beds, where the seedling stand is scattered and germination has continued late should be mulched. One-year-old spruce should also be mulched. Oat straw is used for mulching, since it is the only cheap available material for that purpose. Straw brings in quite a lot of grass seed, but it cannot be avoided. Care should be taken that chaff, which causes heating and mold in spots, be discarded. Six pounds of straw are used per 12-foot bed. Several beds were mulched this fall with excelsior and burlap, to get a check on heating, winter killing and introduction of weeds in the straw mulched beds.

If a heavy snow comes early in the fall before much freezing, it is better to wait until the changing warm and cold days of spring set in, before mulching.

12. Marking the Beds.

The seed beds are numbered with markers made of twenty-gauge galvanized sheet iron. The number plate is

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The seed beds are numbered with markers made of twenty-gauge galvanized sheet iron. The number plate is

3" x 4 1/2". The standard is 1" x 12". Folded on both edges

to give rigidity, and referred to the number plates.

All plots of stock, both transplants and seed-

lings, are fully described on the "Simons Seed Box Marker"

(see plate print). On the card inserted in this marker for

seedling stock is given:

1. Corner plot and number of beds.
2. Species.
3. Source of seed.
4. Date of sowing.
5. Amount of seed per bed.
6. Care and treatment.

Marking transplants: Transplants are marked

to show:

1. Corner of plot and number of beds.
2. Species.
3. Source of seed.
4. Date of stock.
5. Date transplanted.
6. Method.
7. Care and treatment.

Transplanting.

1. System.

In the fall of 1913, an attempt was made to introduce the Taylor System of Scientific Management into the nursery. From a close study of Taylor's "Shop Management" and similar works, the Planting force became convinced that in nursery work, as in no other work in the Service, the methods therein outlined and results obtained were possible to a high degree. These methods are in brief:-

- "1. A science for each element of the work.
2. Careful selection, training, teaching and developing of employees.
3. Cooperation on part of management and employees.
4. Equal division of work and responsibility. Management takes over all work for which it is better fitted."

(Taylor's "Shop Management")

5. Implied, but not actually expressed in the above, is a cardinal principle underlying the whole Taylor System that, aside from the fact that each man be carefully selected, carefully taught and trained, and finally set at work for which he is best fitted, he be paid according to his individual work.

The initial attack on the old Rule of Thumb methods was made in transplanting. After a thorough study of the detail operations and the project as a whole, methods as outlined in the following treatise were adopted. Changes in the new method have been made

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from time to time to conform to prevailing conditions, but the principle upon which the system is based is unchanged and has shown gratifying results. New methods adopted at the Savenac Nursery are termed "Forest Service Methods", abbreviated "F. S."

2. Season. The length of the row is dependant upon the number. All stock is transplanted in the spring, fall planting having been abandoned because of frost heaving. Transplanting is always a rush job as it must be done before the stock starts its season's growth. Last spring the work was started April 15 and completed May 11. It is believed that the transplant season may be lengthened by keeping the seedling stock to be transplanted, in cold storage. The V-shaped trench, aside from costing about

3. Preparation of the Ground. Plowing Job. Also in the old trench. Rotation of crops on our transplant ground has been somewhat irregular. While after a harvest of trees, the ground is generally sowed to a green fertilizer or is summer fallowed, or both, the practice has not been systematized so that all ground is treated alike. The main reason for this is that the different blocks of transplants are scattered instead of being grouped in the field. placed on it, and the hole board cut off at the back, so If the ground is not summer fallowed, it is plowed and cross-plowed in the fall. At least a week before transplanting, it is plowed again, harrowed and

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leveled. Whenever the land is worked, all roots, rocks and rubbish are picked up and hauled away.

The best means for irrigating the transplants should be well studied out before the work starts.

4. Methods.

The length of the row is dependent upon the number of unit crews. It has been found from time studies that 10 boards is the maximum amount one crew should plant to the row, for the additional time required for the planter to walk to plant farther than this from the threading table, is greater than is required to stop operations and move the tables back.

Trenching. A takes a hoe having a blade two feet wide, and cleans The V-shaped trench, aside from costing about 15 cents per M., was a man-killing job. Also in the old trench, it was next to impossible to get the roots properly adjusted, many of them failing to hang vertically in the trench.

The aim in the "F. S. Method" was to get a horse-drawn implement to make an open trench.

The smallest sized one-horse plow obtainable was secured in Spokane, an eight-inch (depth of trench) landside placed on it, and the mole board cut off at the back, so that it would not throw the dirt so far.

It works admirably. The rows are made seven

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inches apart, five rows to the bed. Two feet are left between the beds for irrigation laterals. The order in which the trenched rows are made is shown by the arrows on the following diagram:

The packets are placed four in a crate and taken to the transplant field each morning and work on a go-down across by a trencher horse.

One man can pull 30,000 seedlings for transplanting. Immediately after making a round trip with the plow, the plowman takes a hoe having a blade two feet wide, and cleans the trenches of loose dirt that has fallen back, and rocks, and straightens out any bad crooks in the row. The trench is now ready for planting.

Threading. Threaders. Arrangements, however, are made for The stock to be transplanted is taken up by men selected for that work, men whom we feel can do that work better than any other on the nursery force. Speed in transplanting is partly due to their class of work. The seedlings are lifted with spading forks, estimated in bunches of seventy-five, the dirt shaken from the roots, moderately pruned with a small butcher's cleaver, and then placed in seedling packets.

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Packets: These packets are long, narrow boxes that will hold fifty bunches in two layers. The bunches are separated by long finishing nails driven into the center of the box and protected from drying out by strips of moist burlap placed around each layer. The trees are not puddled or washed at the nursery from the time they germinate until they leave.

The packets are placed four in a crate and taken to the transplant field each morning and noon on a go-devil drawn by a trencher horse.

One man can pull 30,000 seedlings for transplanting per day. This includes digging, bunching, pruning and packing.

Threading Tables: The threading tables are completely covered with canvas. This is necessary, because of the strong wind during the afternoon which would otherwise bother the threaders. Arrangements, however, are made for ventilation. (For details of the table, see photographs).

Planting Board: (See blueprint) The Forest Service planting board is changed in several respects from the Yale board:

1. The principle of holding the seedlings by pressure on the stem rather than on the crown, resulting in no loss from dropping out of seedlings.

These packets are long, narrow boxes that will hold fifty bunches in two layers. The bunches are separated by long thin strips of paper and are protected from drying out by strips of moist paper placed around each layer. The trees are not girdled or washed at the nursery from the time they germinate until they leave.

The packets are placed four in a crate and taken to the transplant field each morning and noon on a go-devil drawn by a trencher horse.

One man can pull 30,000 seedlings for transplanting per day. This includes digging, bunching, packing, and packing.

The transplanting tables are completely covered with canvas. This is necessary, because of the strong wind during the afternoon which would otherwise bother the transplanters. Arrangements, however, are made for ventilation. (For details of the table, see

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bunch of 2. The wood containing notches replaced by a removable galvanized iron strip. This was primarily done to give greater strength in small space by means of the iron, so that the base and clamp of the board could come closer together, allowing the dirt to be pushed in closer to the upper part of the stem of the plant than would have been otherwise been possible. 3. The board is held closed by automatic spring clamps. This does away with the operation of locking the board by means of thumb screws, as in the Yale board. 4. The board is eight and one-half feet long instead of eight feet, and holds seventy plants as compared to sixty-four, resulting in a spacing of one and one-third inches. The number of notches in the board was arrived at by time studies showing the time it took to thread and plant a board. With this number per board, neither threader nor planter is kept waiting for the other. 5. Iron spikes are fastened to the board, so that when set on the edge of the open trench, it will stay in that position while the dirt is being tamped around it. Threading: There is only one threader to each unit crew. The threader pulls the empty board, which has been placed on the table with the wings open by the planter, toward him with his right hand, and grabs a

2. The wood containing notches replaced by a removable galvanized iron strip. This was primarily done to give greater strength in small space by means of the iron. So that the base and clamp of the board could come closer together, allowing the dirt to be pushed in closer to the upper part of the stem of the plant than would have otherwise been possible.

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5. Iron spikes are fastened to the board, so that when set on the edge of the open trench, it will stay in that position while the dirt is being tamped around it.

Thrashing: There is only one thrasher to each

unit crew.

The thrasher pulls the empty board, which has been placed on the table with the wings open, by the planter, toward him with his right hand, and gives a

bunch of seedlings from the packet which is suspended from the table before him, with the other hand, and starts threading. The trees are worked forward with the fingers of the left hand and placed in the board with the right. Poor trees are culled if seen before they are dropped in the board. If not, a good tree is placed in the notch with the poor one. When the board is finished it is closed and pushed down the trap slide with one hand, in one movement, ready for the planter. The empty board again before him is drawn forward with the same hand and threading of the new board begun, etc., etc.

Only two boards are used per crew.

Planting.

There is only one planter to each unit crew.

The planter, after placing the empty board on the table, grabs the full one just threaded and walks out to the trench. He faces the land side of the trench, sets the board on the edge of the land side, tilting it slightly backward, then grabs the "planter's rake" and scrapes the loose dirt against the board, packing the dirt firmly as he walks along the board. Then he walks back one foot on each side of the board. Dropping the rake in readiness for the next board, he grabs one wing of the board with each hand, opens and lifts up the board and carries it to the table.

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each side of the board. Dropping the rake in readiness for
the next board, he grabs one wing of the board with each
hand, opens and lifts up the board and carries it to the
table.

Tallying.

Each planter has the ends of his area of ten board length rows marked with a red flag. If Crew No.1 has finished his row and Crew No.2 lacks two boards of having his finished, planter No. 1 will plant one board in Crew No.2's territory and place a florist pot stake with his crew number, at the end of that extra planted board. Thus each evening, by counting the rows, multiplying by ten, and subtracting or adding extra boards planted as shown by these stakes, an absolute "no cheat on system" for counting the output of each crew is made. This system was adopted this year. Previously a tally register automatically registered each board as it slid from the table, but the threader could boost this device if he chose.

As a result of the system, - principally the adoption of a sliding wage scale and the perfection of a cheat proof means for tallying the output of the crews - transplanting works automatically. in the future the foreman will spend most of his time in preparing the irrigation system for the newly transplanted area. Actual supervision of the crews will be small, only an occasional inspection of the planting being necessary.

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The Transplant Crew - 1915

sliding wage scale. The following is the scale used last spring. Olson - in Charge of Nursery is used,

Wage Scale
Spring 1915.

Foreman are tried out and

Supervision to be paid	Grinding Flow.	Moving Tables
Laying out Beds.	Irrigating.*	Seeing to Repairs.
36	\$2.75	
Plowman. Drives	2.85	Crew #1. Crew #2. Crew #3. Crew #4.
plow horse.	2.90	Threader. Threader. Threader. Threader.
Cleans trenches.	1.95	Planter. Planter. Planter. Planter.
Moves tables.	2.95	
Tends plants.	3.00	husky man the best planter.
Carries water.	3.05	
43	3.10	
44	3.15	

*The foreman makes the irrigation laterals in the center of the 2' space between beds, as each bed is planted.

*Seventy-five plants per board.

The Transplant Crew - 1915

Olsen - in Charge of Nursery

Foreman

Supervision
Laying out Beds.

Foreman, Driver
Plow horse.
Olsen trencher.
Move tables.
Tend plants.
Carries water.

Grinding Flw.
Investigating.

Crew #1. Olsen
Trencher. Trencher.
Planter. Planter.

Moving Tables
Seeing to Repairs.

Crew #2. Olsen
Trencher. Trencher.
Planter. Planter.

*The foreman makes the irrigation laterals in the
center of the 2' space between beds, an each bed is
planted.

Each morning the threader and planter are given the time sheet of the work done the previous day, sliding wage scale. The following is the scale used this not only serves as a means for time of keeping track last spring. Each spring before this scale is used, of their earnings, but tends toward competitive interest between the crews.

Wage Scale
Spring 1915.

Boards* per Hour	Rate per Day	Remarks
36	\$2.75	the young fellow makes the
37	2.85	best threader - girls would
38	2.90	be better - and the short,
39	2.95	husky man the best planter.
40	2.95	
41	3.00	
42	3.05	
43	3.10	
44	3.15	
45	3.20	
46	3.25	
47	3.30	
48	3.35	Foreman
49	3.40	
50	3.45	

*Seventy-five plants per board.

Under normal conditions on a 2,000,000 job, the crews will average 40 boards per hour each, or 12,000 trees per man (24,000 per crew) per day.

In the spring of 1914 the record was reached by this method, when for two hours one crew planted at the rate of sixty-four boards per hour.

Following is a daily record of the output of each crew for the spring transplanting of 1915:

Each morning the thresher and planter are given the time sheet of the work done the previous day. This not only serves as a means for them of keeping track of their earnings, but tends toward competitive interest between the crews.

Daily Time Sheet	
Date	Man
Proj.	Op.
A.M.	Eff. Hr. Gr. Output
P.M.	Eff. Hr. Gr. Output
Remarks	
Foreman	

0 Whether threshing or planting.
 * Boards per hour.
 * Hours worked.

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5. Cultivation and Weeding.

The transplants are cultivated and weeded at least twice a year. Cultivating is done with the Planet Junior hand cultivator. While the Planet Junior takes care of most of the weeds, those between the trees in the row are pulled by hand. This last-mentioned operation is made very thorough in stock that is to be taken up in the fall, when the transplants are gone over for the last time of the season, because, if left, the weeds between the plants become a great hindrance to fast work in pulling and counting the stock.

6. Watering.

All transplants are watered by furrowed irrigation. The main feed and waste ditches are made with the transplant plow. Laterals between each bed are made by hand hoes and shovels. I believe that an irrigation plow attachment for the hand cultivator can be secured that will give satisfactory results and make the work lighter.

During dry weather, the stock is thoroughly watered about once every five days. All irrigating is done during the night, the water being turned onto a plot in the evening and turned off in the morning.

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Estimating the Stock.

Estimates have varied so far from actual counts - as shown when the stock is transplanted or distributed - that it was decided a different scheme for making the estimate was necessary.

The actual amount of stock invariably fell below the estimate. This was due chiefly to one thing:

In estimating the seedlings, one or several assumed average beds were estimated by taking a count from a foot square frame set in that part of the bed supposed to be a fair representation of the whole bed. Just a few of these counts were made and the estimate of all that plot based on these.

In the first place, a ^{er} ~~person~~ is bound to favor a better rather than an average bed, and second, the frame will be set in the best part of the bed. And even though this were not true in some cases, it would be impossible to pick out a bed or several beds from a plot of 100 that would give a fair average for all. When the stand is, say 10,000 per 48 square feet, a difference of 1,000 one way or the other cannot be perceived by a casual glance.

Likewise in the transplants, a hit or miss shot at a few of the rows assumed to be average ones, will be the basis for all the transplants. The tendency is to boost the work, or feel sure of its result that the best rows are really picked as average.

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To do away with the tendency to boost the result of sowing or transplanting, the methods outlined in the following instructions for estimating at Savenac Nursery have made the selection mechanical, and sufficient counts made to well represent the stand.

The fall estimate of all stock on hand was made by the following methods. We were able to check results on one plot of transplants when the stock was distributed. The estimate was 167,000. The actual number of trees gotten out was 180,000.

Method 2.

METHOD OF ESTIMATING SEEDLING STOCK

AT SAVENAC NURSERY.

The counts will be made from a frame six inches wide and of indefinite length, so as to provide for the slightly varying widths of the seed beds. The frequency of the counts will be dependent upon the following scheme:
The total estimate will be made by three methods, called "Method 1, 2 and 3."

Method 1.

A count will be made from one setting of the frame, four feet from the end of every other bed. The settings should alternate in respect to the end of the bed. That is, if the first count is taken from the east end of a bed, the count of the second bed parallel to it will be taken from the west end. The number of trees in

To go away with the tendency to boost the result

of seeing or transposing, the methods outlined in the following instructions for estimating at various intervals have made the selection mechanical, and sufficient counts made to well represent the stand.

The full estimate of all stock on hand was made by the following methods. We were able to check results on one plot of transplants when the stock was distributed. The estimate was 157,000. The actual number of trees gotten out was 180,000.

METHOD OF ESTIMATING STOCK

AT SAVANNAH MURKIN.

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this frame multiplied by twice the length of the bed - in feet - will give the total number of trees in the bed. The counts for each bed estimated are recorded on Form Sn-10, in order that a check may be had when re-estimating for germination, loss, or the like. When one-half the total number of beds has been estimated, the sum total is taken and the average per bed computed. This result multiplied by the total number of beds in the area will give the total stand of seedlings.

Method 2.

A count will be made from one setting of the frame, four feet from the end of every bed. As in Method 1, to distribute the counts as well as possible over the area, in parallel beds bed #1 will be counted on the east end, bed #2 on the west end, bed #3 on the east, etc. The counts in each bed are then multiplied by twice the length of the bed, and this result added with those of the others for the total stand.

Method 3.

This method differs from the two previous ones in that a count will be taken from each end of every bed. The sum of the two counts is multiplied by the length of the bed for the number of trees in that bed, and the results of each bed added for the total stand.

This frame multiplied by two is the length of the bed - in feet - will give the total number of trees in the bed. The counts for each bed estimated are recorded on Form 24-10, in order that a check may be had when re-estimating for estimation, loss, or the like.

When one-half the total number of beds has been estimated, the sum total is taken and the average per bed computed. This result multiplied by the total number of beds in the area will give the total stand of seedlings.

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SELECTION OF METHOD.

Now compare the estimates of the stand made by the three methods.

Method 3 will be most accurate, so #3 will be considered 100% efficient. By the "Law of Probabilities" Method 2 will be more efficient than Method 1. But in a series of estimates on this scale, we will find that the relation between the ratios of Method 2 to Method 3, and Method 1 to Method 3 will vary. Method 3 is too expensive. Method 2 will perhaps be 98% efficient, and Method 1, 96%. In this case it will be cheaper to use Method 1, since the difference in efficiency is only 2%, yet the cost of Method 2 is double that of Method 1.

In estimating for selection of method to be used, Methods 1 and 2 can be taken from the notes on Method 3.

Totals

in Area

Total Beds: Ayr. per Bed per Sq. Ft. Stand

Method

Estimated By

SELECTION OF METHOD.

Now compare the estimates of the above made by the three methods.

Method 2 will be most accurate, as it will be considered 100% efficient. By the "law of probabilities" Method 2 will be more efficient than Method 1. But in a series of estimates on this scale, we will find that the relation between the ratios of Method 2 to Method 1, and Method 1 to Method 2 will vary. Method 2 is too expensive. Method 2 will perhaps be 98% efficient, and Method 1, 95%. In this case it will be cheaper to use Method 1, since the difference in efficiency is only 3%, yet the cost of Method 2 is double that of Method 1.

In estimating for selection of method to be used, Methods 1 and 2 can be taken from the notes on

Method 3.

METHOD OF ESTIMATING TRANSPLANTS

AT SAVENAC NURSERY.

Form SN-10.

The counts will be taken from the setting of
SEEDLING ESTIMATE
 a straight strip of wood the length of the transplant
 boards - 3 1/2 feet - placed alongside the row.
 Savenac Nursery Date _____
 Stock _____

The first count will be taken 3 1/2 feet from
 the end of the first row in the first bed. Every other
 Bed No.: End: Length : Count : Total
 1st is : 1st, so the second count will be 3 1/2 feet from
 the end of the second row in the first bed, and the third
 count in the third row of the fifth bed, etc., etc.,
 until the area has been crossed.

Then the estimator will come back in the center
 of the area, selecting his settings in the same mechanical
 manner. The beds in which the counts are made on this
 trip, however, are those that were skipped when the area
 was first crossed.

The third trip across the area is made 3 1/2 feet
 from the opposite end of the rows first estimated.

Totals The data obtained is noted on the special forms
 In Area
 Total Beds: Avr. per Bed per Sq. Ft. Stand

Method From Estimated By the average per board is
 computed, and the per cent loss, based on the seventy-five
 trees per board, obtained. This per cent loss is deducted
 from the total transplanted, the result being an estimate
 of the present stand.

Form EN-10.

SEEDLING ESTIMATE

Seeds per Acre _____ Date _____

Stock _____

Total	:	Count	:	Area	:	Seed	:
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:
:	:	:	:	:	:	:	:

Total

in Area

Total Seed: Av. per Acre per Sq. Ft. Stand

Method _____ Estimated by _____

METHOD OF ESTIMATING TRANSPLANTS
AT SAVENAC NURSERY.

Form SN-10a

The counts will be taken from the setting of a straight strip of wood the length of the transplant boards - $8\frac{1}{2}$ feet - placed alongside the row.

The first count will be taken $8\frac{1}{2}$ feet from the end of the first row in the first bed. Every other bed is skipped, so the second count will be $8\frac{1}{2}$ feet from the end of the second row in the ^hthird bed, and the third count in the third row of the fifth bed, etc., etc., until the area has been crossed.

Then the estimator will come back in the center of the area, selecting his settings in the same mechanical manner. The beds in which the counts are made on this trip, however, are those that were skipped when the area was first crossed.

The third trip across the area is made $8\frac{1}{2}$ feet from the opposite end of the rows first estimated.

The data obtained is noted on the special forms for this purpose (Form SN-10a).

From these notes the average per board is computed, and the per cent loss, based on the seventy-five trees per board, obtained. This per cent loss is deducted from the total transplanted, the result being an estimate of the present stand.

METHOD OF ESTIMATING TRANSPLENTS
AT SAVANNAH NURSERY.

The counts will be taken from the setting of
a straight strip of wood the length of the transplanted
boards - 8 1/2 feet - placed alongside the row.
The first count will be taken 8 1/2 feet from
the end of the first row in the first bed. Every other
bed is skipped, so the second count will be 8 1/2 feet from
the end of the second row in the first bed, and the third
count in the third row of the fifth bed, etc., etc.,
until the area has been crossed.
Then the estimator will come back in the center
of the area, selecting his settings in the same mechanical
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of the present stand.

Stock Distribution.

1. Form SN-1Ca.

The spring stock distribution was carried on very much TRANSPLANT ESTIMATE with the exception Savenac Nursery Date namely, a horse-drawn tree Stock. Formerly the stock was lifted by grades, -

End	Bed	Row	Count	Remarks

the device used was a roughly iron digger was a plow, except that the share is an I-shaped knife, and the device drawn by two horses in tandem. The knife cuts into the trees about seven inches below the surface. A wedge-shaped piece of iron attached to the knife blade on inch back of the cutting edge causes the row of trees to slide up this incline made by the wedge, which is thus raised sufficiently to result in a sort of separation of the roots and breaking of the soil when the slice of earth falls back into place, as it were, behind the plow, so that the trees are easily pulled from the ground, yet the roots are not at all exposed. As with the trencher plow,

Totals drawn the horse and the guided the plow.

Due to Estimated By in the handling of the equipment, considerable loss in lifting the trees resulted at the start. The plow would strike a root or stone,

Form 88-10a.

TRANSLANT ESTIMATE

Date

Sevensbury

Stock

End	Pos	How	Count	Remarks

Totals

Estimated by

causing the share to come to the surface. Instead of
Stock Distribution.
stopping, the plowman would go right on, working the

1. Spring Distribution. the "run". As a result, many

The spring stock distribution was carried on very much the same as in the past, with the exception of one important change, namely, a horse-drawn tree digger. Formerly the stock was lifted by spades, -with another man-killing job. A Feighly Tree Digger was purchased and tried out. to keep twenty men busy pulling.

The implement is very much on the order of a plow, except that the share is an L-shaped knife, and the device drawn by two horses in tandem. The knife cuts the trees about seven inches below the surface. A wedge-shaped piece of iron attached to the knife blade an inch back of the cutting edge causes the row of trees to slide up this incline made by the wedge, which is thus raised sufficiently to result in a sort of separation of the roots and breaking of the soil when the slice of earth falls back into place, as it were, behind the plow, so that the trees are easily pulled from the ground, yet the roots are not at all exposed. As with the trencher plow, one man drives the horses and one guides the plow.

Due to inexperience in the handling of the implement, considerable loss in lifting the trees resulted at the start. The plow would strike a root or stone,

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implement, considerable loss in lifting the trees resulted

at the start. The plow would strike a root or stone,

causing the share to come to the surface. Instead of stopping, the plowmen would go right on, working the plow back into place on the "run". As a result, many trees would be cut too shallow. Readjustment of the clevice and handles was also necessary before the plow could be easily guided.

Where it formerly took one man to lift with a spade what two men pulled, two men can now lift with the tree digger enough to keep twenty men busy pulling.

The advantage of making long rows in transplanting is renewed in tree lifting, because turning at the end of each row takes considerable time, and it is often necessary to dig up the ends of the plot by hand to allow turning room for the horses.

The order in which the rows are lifted with the Feighley Tree Lifter is indicated in the following diagram. This order is necessary to allow members of a large crew to work without interfering with each other, and to allow time for pulling the first row before the one adjacent is plowed, to avoid any injury to the trees already lifted by the plow horse.

6
12
15
11
5

of the planting job was figuring as closely as possible what stock he needed per day, could be handled at the

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could be easily guided.

Where it formerly took one man to lift with
a spade what two men guided, two men can now lift with
the tree digger enough to keep twenty men busy pulling.
The advantage of making long rows in trans-
planting is renewed in tree lifting, because turning at
the end of each row takes considerable time, and it is
often necessary to dig up the ends of the plot by hand to
allow turning room for the horses.

The order in which the rows are lifted with
the digger is indicated in the following
diagram. This order is necessary to allow members of
a large crew to work without interfering with each other,
and to allow time for pulling the first row before the one
adjacent is plowed, to avoid any injury to the trees already
lifted by the plow horses.

nursery by a few additional men taken from other work.	4
←	10
←	14
9	→
3	→
orders that might come, so all stock was pulled and packed	2
←	8
13	→
7	→
1	→

2. Fall Distribution.

Since distribution in the fall came at such an opportune time as to give it undivided attention, it was possible to carry on a number of experiments which it was believed would better the carrying out of that project as a whole. By the close of the season there was hardly a principle of the work that had not been changed from methods used in past years.

As already discussed under "Spring Distribution", the method of lifting the stock was entirely different.

Methods: Men in charge of the planting jobs were instructed to take particular pains in gauging the amount of stock they could plant per day, and so know several days in advance what to order. In this way the nursery had on hand several days in advance, the orders to be shipped, and encountered but few rush ^{orders} being few and calling for only small amounts, because the man in charge of the planting job was figuring as closely as possible what stock he needed per day, could be handled at the

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2. Fall Distribution.

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nursery by a few additional men taken from other work, causing no confusion in the system. As a result, it was not necessary to pull and heel in stock in readiness for orders that might come, so all stock was pulled and packed the day it was shipped, thus doing away with the extra operation of heeling in. This operation costs \$.005 per thousand. The crates out were returned to the nursery. The crate

The men follow the tree lifter, pull the trees and tie them in bunches of 100 each, they lay the bunch down and cover the roots with a handful of dirt. It might be mentioned here that costs might be reduced an appreciable amount if some no-knot tying device can be conceived of. The present method of tying the bunches with string takes considerable time.

The packing is done just before train time when the trees are to be shipped. The bunches are thrown into the wagon and hauled to the packing machine, or carried in large wire baskets.

The stock was formerly packed in a specially designed shipping crate of two sizes, the smaller one holding on an average of 2,000 plants and the larger about 4,000. The cost of the wood material alone in these crates was $16\frac{1}{2}$ cents and $27\frac{1}{2}$ cents, respectively. Adding the cost of nails and work in putting them together, the total cost was about $18\frac{1}{2}$ cents and 30 cents each. The

necessity by a few additional men taken from other work, causing no confusion in the system. As a result, it was not necessary to pull and heel in stock in readiness for orders that might come, so all stock was pulled and packed the day it was shipped, thus doing away with the extra operation of heeling in. This operation costs \$1.000 per thousand.

The men follow the tree litter, pull the trees and tie them in bunches of 100 each, they lay the bunch down and cover the roots with a handful of dirt. It might be mentioned here that costs might be reduced an appreciable amount if some no-knot tying device can be conceived of. The present method of tying the bunches with string takes considerable time.

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The stock was formerly packed in a specially designed shipping crate of two sizes, the smaller one holding on an average of 2,000 plants and the larger about 4,000. The cost of the wood material alone in these crates was 15¢ cents and 25¢ cents, respectively. Adding the cost of nails and work in putting them together, the total cost was about 18¢ cents and 30 cents each. The

weight of the larger box (which was the most economical) was 22 pounds, this being dead weight on every 4,000 trees shipped. The cost made it desirable to return the crates from jobs near the railroad, yet their weight made it impracticable to return them by pack train from jobs at a distance from the railroads. In reality, only about one-half the crates sent out were returned to the nursery. The crate was built to last two shipments, but for the reason given above, the cost of crating amounted to 75% of the initial cost of the crates. This brought the cost of crating 4,000 trees to 22 cents, or $5\frac{1}{2}$ cents per 1,000. Packed, the boxes weighed about 110 pounds, a heavy and inconvenient container to handle.

This fall burlap rolls were used in all our shipments, in substitution for the old style wood crates. The device for making the rolls is somewhat on the order of a shingle weaving machine. (See photographs). Specifications for this device are being prepared for Ogden, in accordance with circular letter of June 14, 1915.

Two six-foot lengths of lath yarn fastened to two wooden cleats (the cleats eighteen inches apart and the two lengths of lath yarn twelve inches apart) two feet long by means of poultry netting staples are first placed in the bottom of the packer. A strip of burlap six feet long and twenty-one inches wide is placed over the lath yarn and cleats, and over the burlap is laid

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This roll burlap rolls were used in all our shipments, in substitution for the old style wood crates. The device for making the rolls is somewhat on the order of a simple weaving machine. (See photograph). Specimens for this device are being prepared for export, in accordance with circular letter of June 14, 1915.

Two six-foot lengths of lath were fastened to two wooden cleats (the cleats eighteen inches apart and the two lengths of lath were twelve inches apart) two feet long by means of poultry netting staples are first placed in the bottom of the packer. A strip of burlap six feet long and twenty-one inches wide is placed over the lath yarn and cleats, and over the burlap is laid

a six-foot sheet of eighteen inch "Butcher's" wrapping paper. The bunches of trees, after being moderately pruned, are then laid in the packer in two tiers, roots to the center, each layer being well packed in wet shingle tow. When the container is full, the ends of paper and burlap are drawn together at the top. The ends of the burlap are wrapped around a good hard strip of wood, - tamarack - 1" x 2" x 2'. The ends of this stick will extend about two inches beyond the edges of the burlap. On these uncovered ends a grip is secured by means of a long tool - sixteen inches - similar to a wagon hammer. With this purchase the burlap can be twisted as tight as the tearing resistance of the burlap will permit. When the burlap has been drawn up good and tight, this wrenching tool is held in position by means of a catch on the packer. The hands are now free to tie the bundle with the lath yarn. This completes the operation. The front side of the packer is let down and the bundle taken out.

Cost The burlap strips are saved in the field and at the close of the season shipped back to the nursery. It is not known what the life of the packing material is, but I am sure it will last three years. A comparison in cost of these two means of packing is shown in the following:

a six-foot sheet of asphalt such "Antcher's" wrapping
paper. The bundles of trees, after being moderately
pinned, are then laid in the packer in two tiers, roots
to the center, each layer being well packed in wet shingle
fow. When the container is full, the ends of paper and
burlap are drawn together at the top. The ends of the
burlap are wrapped around a good hard strip of wood,
- tamarack - 1" x 2" x 2'. The ends of this strip will
extend about two inches beyond the edges of the burlap.
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the burlap has been drawn up good and tight, this wrenching
tool is held in position by means of a catch on the packer.
The hands are now free to tie the bundle with the lath form.
This completes the operation. The front side of the packer
is let down and the bundle taken out.
The burlap strips are saved in the field and at
the close of the season shipped back to the nursery. It
is not known what the life of the packing material is, but
I am sure it will last three years. A comparison is sent
of these two means of packing is shown in the following:

Laid from a considerable lowering of cost, the new method has other advantages, namely:

Cost of Material for Tree Shipments.

Advertisements: The bundles are attractive, and their open ends display the contents to a large number of people who see the loading of exports through the car windows.

Large Shipping Crate.

Burlap Roll.

Number of trees per crate.....4,000 : Roll.....4,000

Life 2 years. bundle is : 3 years.

Cost of material: Lumber	\$.28	: Cleats	Scrap Lumber
		: Rope	.036
		: Paper	.018
		: Burlap	.065
Labor	.02		.030
Total	.50		.14

Loss through breakage and amount not returned from field before the second shipment is 25%. Hence \$.30 is only 75% of the cost of the crates for a two-year service, and the total cost for that period is

Cost of moss12 : Shingle tow012

Actual cost of crating 8,000 trees \$.52 : 12,000 trees .. .15

Cost per M. \$.061 :01-1/2

have been received in good condition.

For short time shipments (at the most four days) the moss has no advantage over the shingle tow. The last order of moss came from Wisconsin, costing \$30.00 per ton F.O.B. Hagan. It was necessary to fumigate this to rid the moss of the larch saw fly. The shingle tow, on the

Buried Roll.

Is the following true?

Number of trees per acre 5,000

Life 3 years. 3 years : 3 years.

Cost of material: lumber		Cost of material: lumber	
Clears	1.28	Clears	1.28
Boards	1.00	Boards	1.00
Shingles	1.00	Shingles	1.00
Roofing	1.00	Roofing	1.00
Other	1.00	Other	1.00
Total	5.28	Total	5.28
Loss through breakage and amount not returned from field before the second shipment is 25%.		Loss through breakage and amount not returned from field before the second shipment is 25%.	
Hence \$.30 is only 75% of the cost of the crates for a two-year service, and the total cost for that period is		Hence \$.30 is only 75% of the cost of the crates for a two-year service, and the total cost for that period is	
1.40	1.40	1.40	1.40
Cost of	1.12	Cost of	1.12
Shingle tow	1.01	Shingle tow	1.01
Actual cost of crating 8,000 trees	1.12	Actual cost of crating 8,000 trees	1.12
Cost per M.	1.01	Cost per M.	1.01

Aside from a considerable lowering of cost, the new method has other advantages, namely:

Advertisement: The bundles are attractive, and their open ends display the contents to a large number of people who see the loading of express shipments from the car windows.
Number of trees per bundle is flexible.
Bundles easier to handle en route than boxes. One man can pack twice as many trees per day (approximately half a million).
A better pack for pack horses.
The average per bundle is 4,000 trees.
Weight, ninety pounds.
Easy to handle at the plantation. The bundle will not break like a box when thrown around. The whole bundle may be dipped in water if so desired, instead of individual bunches.

The trees do not dry out or heat, in the time it will take to transport them to any part of the District. These bundles have been left in a warm place for six days and the trees were cool and moist when the bundle was opened.

In the past, all trees were packed in sphagnum moss. Last spring some experimenting was done with shingle tow - the saw kerf from a shingle mill. The results were satisfactory, so all fall shipments were packed in this and a close record of the condition of the stock on arriving at its destination kept. All shipments were reported to have been received in good condition.

For short time shipments (at the most four days) the moss has no advantage over the shingle tow. The last order of moss came from Wisconsin, costing \$30.00 per ton F.O.B. Haugan. It was necessary to fumigate this to rid the moss of the larch saw fly. The shingle tow, on the

Aside from a considerable lowering of cost, the

new method has other advantages, namely:

Advertisement: The bundles are attractive, and their open ends display the contents to a large number of people who see the loading of express shipments from the car windows. Number of trees per bundle is flexible. Bundles easier to handle on route than boxes. One man can pack twice as many trees per day (approximately half a million). A better pack for pack horses. The average per bundle is 4,000 trees. Weight, ninety pounds. Easy to handle at the plantation. The bundle will not break like a box when thrown around. The whole bundle may be dipped in water if so desired instead of individual branches.

The trees do not dry out or heat, in the time it will take to transport them to any part of the District. These bundles have been left in a warm place for six days and the trees were cool and moist when the bundle was opened. In the past, all trees were packed in sphagnum moss. Last spring some experimenting was done with shingle tow - the new sort from a shingle mill. The results were satisfactory, so all fall shipments were packed in this and a close record of the condition of the stock on arriving at its destination kept. All shipments were reported to have been received in good condition.

For short time shipments (at the most four days) the moss had no advantage over the shingle tow. The last order of moss came from Wisconsin, costing \$30.00 per ton T.O.B. Bangor. It was necessary to fumigate this to rid the moss of the larva saw fly. The shingle tow, on the

other hand, is gotten at the shingle mill less than a mile from the nursery, at the cost of hauling only. Last fall, about seven tons were hauled and stacked at a cost of \$2.00 per ton.

Dear Sir: Shingle tow, like moss, will pack about 1,000 trees to the pound.

Each bundle is stenciled to show the number of trees, species and age class. Next year the new stencil - design of standard badge - supplied at Ogden, will be used on the bundles. Also the form on the following page, sealed in an oiled envelope, will accompany each consignment. This is a District 6 form.

Additional time studies with a stop watch will be made, and an attempt made to put the operations of this project on a sliding wage scale similar to that now used in transplanting.

Very truly yours,

In Charge.

(over)

other hand, is gotten at the shingle mill less than a
mile from the nursery, at the cost of hauling only. Last
fall, about seven tons were hauled and stacked at a cost
of \$2.00 per ton.

Shingle tow, like moss, will pack about 1,000

trees to the pound.

Each bundle is stamped to show the number of
trees, species and age class. Next year the new stamp -
design of standard badge - supplied at Ogden, will be used
on the bundles. Also the form on the following page, sealed
in an oil envelope, will accompany each consignment. This
is a list of 3 forms.

Additional time studies with a stop watch will be
made, and an attempt made to put the operations of this
project on a sliding wage scale similar to that now used
in transplanting.

Savenac Nursery. September 15, 1915.

Dear Sir:

The following shipment of nursery trees consisting of 20 B'bles... is being made today via.... Northern Pacific.... on Government bill of lading No. 52963. consigned to Forest supervisor, Sandpoint, Idaho.

Number:	Number:			Source of	
M.	Rolls:	Species	Age	Seed	Remarks
40	10	W.W.P.	1-2	Keniksu	Fertilized
20	5	W.W.P.	2-0	"	"
20	5	W.Y.P.	1-2	Bitterroot	Unfertilized

This is the final shipment of Western yellow pine... Stock.

Please describe fully on the reverse side of the enclosed extra copy of this letter, the condition in which the trees reached you and forward it to the District Forester. This information is desired in order that we may know whether changes are necessary in our methods of packing.

Very truly yours,

In Charge.

(Over)

Directions: Consignee should fill out this report in duplicate on the two forms received from the consignor, forward one to the District Forester and retain the other in the files.

Date shipment reached end of railroad or stage line. Sept. 16/1915

Date received from railroad or stage company. Sept. 16, 1915.

Date unpacked at planting site.....

How were trees treated after receipt from transportation co.?

Watered in transit by pack train.

Heeled in at planting site.

Condition of rolls when received; describe in detail if in bad

shape Good.

Ropes loosened on 2 bundles.

Condition of the trees: Were the roots moist or dry; was the packing of moss or shingle-tow moist or dry; was there any sign of heating; did the tops show any signs of wilting or of mildew; were they bruised or broken in any way; had any of the bundles become dislodged from their original position in the package; was there any difference in the condition of the trees in the middle of the package from those near the outside; in what condition were the trees as a whole?

Trees in excellent condition.

Date ... Sept. 16, 1915.....

(revd) (Signed)

(Title) Forest Supervisor.

Seedling Stock Distribution: Seedling stock is lifted from the beds by means of spading forks. A horse-drawn implement that will lift the seedlings and can be converted into an underground root pruner for the seed beds is being worked on, but as yet it has not been perfected.

The seedling stock is pulled and packed in the same manner as the transplants. Wages paid to the different classes of labor in 1915 were as follows:

Transplant crew	On a sliding wage scale.
Initial wage on other crews	\$2.75 per day.
Experienced men in nursery work	3.00 " "
Foreman	3.25 " "
Headman	3.25 " "
Cook	50.00 " mo.
Age of Transplant Stock When Shipped:	35.00 " "

From these wages, the men pay 15 cents per meal. This amount covers the actual cost of running mess.

P. ponderosa 1-2
P. monticola 1 & 2-2
P. strobus 1 & 2-2

Picea Engelmanni 2-2
Larix occidentalis 2-2
Thuja plicata 2-2
Hardwoods *

The initial wage on other crews will be reduced to \$2.50 per day.

3. The cook's wage will be raised to \$55.00 per month.
*Variable.

The initial wage will be further reduced, until it is \$2.25 per day, but it must be reduced gradually to this amount. When \$2.25 has been standardized, the foreman

.....the same manner as the transplants.
.....The seedling stock is pulled and packed in
.....boxes in being worked on, but as yet it has not been
.....converted into an underground root system for the need
.....of the experiment that will lift the seedlings and can be
.....lifted from the beds by means of special forks. A horse-

and old men will have their wages reduced 25 cents per day.
Labor.

This change has become necessary in order that men might

be given. There has been no difficulty in securing temporary labor at the nursery, at any time of the year.

While most of this help consists of floaters, still there are sufficient old hands available to carry on the work smoothly.

Wages paid to the different classes of labor in 1915 were as follows:

Transplant crew	On a sliding wage scale.
Initial wage on other crews.....	\$2.75 per day.
Experienced men in nursery work.....	3.00 " "
Foreman	3.25 " "
Teamster	3.25 " "
Cook	50.00 " mo.
Flunky	55.00 " "

From these wages, the men pay 25 cents per meal. This amount covers the actual cost of running mess.

For the next year, the following changes in wages are contemplated:

1. The men on the Stock Distribution crew will be paid by piece rate.
2. The initial wage on other crews will be reduced to \$2.50 per day.
3. The cook's wage will be raised to \$55.00 per month.

The initial wage will be further reduced, until it is \$2.25 per day, but it must be reduced gradually to this amount. When \$2.25 has been standardized, the foreman

and old men will have their wages reduced 25 cents per day. This change has become necessary in order that men might be given a bonus for extra efforts and good results. Under the past scale of wages, the foreman was paid \$3.25 because several of his men had been retained from the initial wage of \$2.75 to \$3.00. At this rate the director and his assistants at the nursery were receiving a smaller wage per day than their field foreman.

The following table shows the wages of the men employed at the nursery and the field foreman. The wages of the men employed at the nursery are shown in the first column and the wages of the field foreman are shown in the second column.

From the above table, it can be seen that the wages of the men employed at the nursery are lower than the wages of the field foreman.

The reason for this is that the men employed at the nursery are not as experienced as the field foreman.

For this reason, the wages of the men employed at the nursery are lower than the wages of the field foreman.

Wages are shown in the following table:

1. The wages of the men employed at the nursery are shown in the first column.

2. The wages of the field foreman are shown in the second column.

3. The wages of the men employed at the nursery are shown in the third column.

4. The wages of the field foreman are shown in the fourth column.

5. The wages of the men employed at the nursery are shown in the fifth column.

6. The wages of the field foreman are shown in the sixth column.

7. The wages of the men employed at the nursery are shown in the seventh column.

8. The wages of the field foreman are shown in the eighth column.

9. The wages of the men employed at the nursery are shown in the ninth column.

10. The wages of the field foreman are shown in the tenth column.

IMPROVEMENTS.

During the year 1915, a number of important improvements were made:

1. The high-line water ditch was constructed to give sufficient water for the seed beds and domestic purposes. The total cost of this ditch - which is over a mile long and flumed about 1,--- feet - was \$885.00.

2. A pole bridge 60 feet long was laid over the slough in front of the nursery to enable us to get river sand whenever desired. Formerly it was necessary to go around over the county road bridge, then back and ford the river to the beach, making it about 1/4 mile hauls, and the sand had to be gotten when the water in the river was low, when fording was possible. This bridge also reduces the haul to about 500 feet. The cost of constructing the bridge was \$38.00.

The nursery street and walks were filled with fine crushed rock. This rock is gotten close by from a rock slide. The clay and sand mixture with this rock serves as a fine natural binder, so the effect is very much like a macadamized road. Total expenditures on this work were \$45.00.

A neat, three-pole fence was set out in front of the nursery and white-washed, at a cost of \$1.25 per rod. A similar fence will be put up on the other side

IMPROVEMENTS.

During the year 1915, a number of important

improvements were made:

1. The high-line water ditch was constructed to give sufficient water for the feed beds and domestic purposes. The total cost of this ditch - which is over a mile long and flumed about 1,000 feet - was \$385.00.

2. A pole bridge 60 feet long was laid over the slough in front of the nursery to enable us to get river sand whenever desired. Formerly it was necessary to go around over the county road bridge, then back and ford the river to the beach, making it about 1 1/4 mile haul, and the sand had to be gotten when the water in the river was low, when fording was possible. This bridge also reduces the haul to about 500 feet. The cost of constructing the bridge was \$28.00.

The nursery street and walks were filled with fine expanded rock. This rock is gotten close by from a rock slide. The clay and sand mixture with this rock serves as a fine natural binder, so the effect is very much like a macadamized road. Total expenditure on this work was \$45.00.

A new, three-pole fence was set out in front of the nursery and white-washed, at a cost of \$1.25 per rod. A similar fence will be put up on the other side.

of the road next year, in front of the nurseryman's house.

The District storehouse, formerly used for storing planting equipment and supplies, was converted into a barn. This building makes a roomy barn, having two single and a double stall, harness room and out bins, and loft for 15 tons of hay.

The old tool house was made over to serve as an office, and the large bunk house converted into a tool and storehouse.

Sleeping accommodations are under construction in the way of four two-room bunk houses, each building for twelve men (See blue-print).

The moss house was put on skids and moved to the rear of the tool house, where it now serves as a blacksmith shop.

A special effort was made to line up all buildings, roads, fences and seed beds in a systematic order, but this work cannot be finished until the seedlings now occupying the beds have been taken up. Also, the grounds are being planted with various trees, hedges and shrubs, in an attempt to bring out the aesthetic value of the nursery. It is felt that an attractive nursery will add materially to the publicity work of the Service, because of the large number of tourists stopping at Savenac during the summer. The approach to the nursery on the "Yellowstone Trail" are advertised by large signs, as shown in the accompanying photograph. All

of the road next year, in front of the nursewoman's house.
The District storehouse, formerly used for
storing planting equipment and supplies, was converted
into a barn. This building makes a roomy barn, having
two stalls and a double stall, harness room and car bin,
and left for its own use.
The old tool house was made over to serve as an
office, and the large brick house converted into a tool
storehouse.
Sleeping accommodations are under construction
in the way of four two-room bunk houses, each building to
house twelve men (see photo-print).
The main house was put on skids and moved to the
rear of the tool house, where it now serves as a mess
shop.
A special effort was made to line up all building
roads, fences and seed beds in a systematic order, but the
work cannot be finished until the seedlings are ready
the beds have been taken up. Also, the grounds are being
planted with various trees, bushes and shrubs, in an effort
to bring out the aesthetic value of the nursery. It is
felt that an attractive nursery will add materially to the
published work of the Service, because of the large number
of plants growing at various stages of the nursery. The app-
earance of the nursery on the "Yellowstone Trail" are described
large signs, as shown in the accompanying photograph.

visitors are requested to enter their name and place of residence in the register kept at the nursery.

The following improvements are contemplated during the year 1916:

A telephone will be installed in the transplant field, in connection with the office 'phone.

I wish to recommend that a new suspension foot bridge be constructed across the St. Regis River. This crossing is used in pedestrian travel between the nursery and Haugan. The present bridge is not only dangerous, but a disagreeable appearing structure for the entrance to the nursery.

visitors are requested to enter their name and place of residence in the register kept at the nursery.

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during the year 1916:

A telephone will be installed in the transparent field, in connection with the office phone. I wish to recommend that a new suspension foot bridge be constructed across the St. Regis River. This crossing is used in pedestrian travel between the nursery and Haugan. The present bridge is not only dangerous, but a disagreeable appearing structure for the entrance to the nursery.

Approximate Cost of Improvements
at Savenac Nursery up to January 1, 1916.

Nurserymen's house	\$650.00
Office	172.00
Tool and storehouse	575.00
One-half interest in Lolo Forest and nursery bunk house	100.00
Cook house	575.00
Commissary	30.00
Stain and painting of rough buildings in above....	125.00
Root cellar	50.00
Bath house	65.00
Barn	405.00
Wagon shed	50.00
Other buildings - wood shed - blacksmith's shop, meat house, etc.	300.00
Clearing, breaking and fertilizing the land	3,640.00
Fencing	200.00
Roads, culverts, bridges, walks, seeding pasture, etc.	490.00
Water system - ditches, gates, dams, flumes, etc..	1,490.00
Pipe fittings - water system	850.00
Shade and screen frames	600.00
Tools, implements, cook house equipments, stoves, and miscellaneous small fixtures and equipment..	2,800.00
Nursery team	<u>450.00</u>
Total	\$13,617.00

Approximate Cost of Improvements

at Savana Nursery No. 1 January 1, 1916.

\$550.00	Nurseryman's house
175.00	Office
275.00	Tool and storeroom
100.00	One-half interest in Palo Verde and nursery bank house
275.00	Cook house
30.00	Community
125.00	Stain and painting of rough buildings in above
50.00	Root cellar
65.00	Bath house
400.00	Barn
50.00	Wagon shed
200.00	Other buildings - wood shed - blacksmith's shop, meat house, etc.
3,640.00	Clearing, breaking and fertilizing the land
200.00	Fencing
400.00	Roads, ditches, bridges, wells, seeding pasture, etc.
1,450.00	Water system - ditches, gates, dams, lines, etc.
650.00	Pipe fittings - water system
600.00	Shade and screen lines
2,800.00	Tools, implements, cook house equipment, stoves, and miscellaneous small fixtures and equipment
450.00	Nursery team
\$13,615.00	Total

It is believed POLICY vision in the cost

keeping system of the nursery will be necessary. Up to
Taylor's System of Management will be further
carried on in general nursery practice. The development
of this system, however, must be gradual, and every move
made well studied out in every detail

In a broader sense, that is, in changes that
will secure a greater prosperity for the management
directly, - indirectly to the employee - and pave the
way for carrying on all the work on a strictly scientific
management basis, the management of the nursery can be
bettered in leaps and bounds.

To illustrate: The hardest part in introducing
radical changes in a system is to make the men give up
their prejudice against any innovation, and their "stand
patism" on the old way of doing things. A more scientific
manner of handling mess, work animals, improvements and
maintenance, and better systems of handling administrative
work are crowding the nursery schedule for attention.
Also new devices for other projects are to be experimented
with, while the slow progress of helping and coaxing out
100% efficiency from the employee and adjusting wage scales
is being worked out with detailed time studies.

An inspection of all nursery stock will be made
daily during the spring and summer, in order that any
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An inspection of all nursery stock will be made daily during the spring and summer, in order that any disease or other injury to the stock may be detected and remedied before considerable damage is done.

apportionment. It is believed that a revision in the cost accounting system at the nursery will be necessary. Up to date, all items listed under permanent improvements dating back to 1910 have been given a twenty-year life. While perhaps the greatest portion of the total expenditures for permanent improvement will outlive the twenty years, still there are many items which will not. An attempt will be made to judge the length of service of these last-mentioned items, and thus clear them from the books as soon as is justifiable by officer in charge.

All land charges, disbursements for clearing the land originally, and subsequent improvements in dirt ditches, have been charged annually on a twenty-year depreciation basis. This is clearly an error, since there is no depreciation whatever on land, but rather an increased value from year to year, both for land and ditches. I think it advisable to take these queries up with the Washington Office, in an attempt to standardize the cost keeping system.

Nor should interest on the money expended for land improvements be charged, unless we make interest charges also for tools, implements and all items under permanent improvements.

Respectfully submitted,

(Signed) D. S. Olson

In Charge.

From the summary of costs in this report, it is shown that, aside from the amounts expended directly on each project, \$320.34 for Work Animals, \$1,108.50 for Administration, \$1,371.58 for Maintenance, and \$681.88 for Apportionment of Permanent Improvements, must be

It is believed that a revision in the cost keeping system at the nursery will be necessary. Up to date, all items listed under permanent improvements dating back to 1910 have been given a twenty-year life. While perhaps the greatest portion of the total expenditures for permanent improvement will outlive the twenty years, still there are many items which will not. An attempt will be made to judge the length of service of these last-mentioned items, and thus clear them from the books as soon as is justifiable.

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From the summary of costs in this report, it is shown that, aside from the amounts expended directly on each project, \$380.34 for Work Animals, \$1,108.80 for Administration, \$1,271.58 for Maintenance, and \$681.88 for Appointment of Permanent Improvements, must be

apportioned among the six major projects. These amounts affect the actual cost of each project very appreciably, and as a result project costs of different nurseries cannot be fairly compared unless the cost keeping system is standardized.

I should like to have you inform me, whether or not all Forest Service nurseries charged to their costs of tree production:

1. Land charges.
2. All items under permanent improvements.
3. Clerical work done by officer in charge.
4. Ranger's, or other Forest officers' help.
5. The time the draft animals actually spent on each project, which at \$1.00 per day would at the most amount to only \$100.00 a year, or the cost of keeping the team when working and in the stable the year round.

I think it advisable to take these queries up with the Washington Office, in an attempt to standardize the cost keeping system.

Respectfully submitted,

(Signed) D. S. Olson

In Charge.

January 15, 1916.

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I should like to have you inform me, whether or not all Forest Service nurseries charged to their costs of the production:

1. Land charges.
2. All items under permanent improvements.
3. Official work done by officer in charge.
4. Ranger's, or other Forest Officer's help.
5. The time the Forest Officer actually spent on each project, which at \$1.00 per day would at the most amount to only \$100.00 a year, or the cost of keeping the team when working and in the stable the year round.

I think it advisable to take these queries up with the Washington Office, in an attempt to standardize the cost keeping system.

Respectfully submitted,

(Signed) D. S. Olson
In Charge.

January 15, 1916.

Savannah Nursery

Cost Data

Project 2

Calendar Year 1915

Measurements

Second Year

Feed Costs

Cost per Fed

Labor \$477.54

Merchandise 22.88

Total \$500.42

529

\$.95

Minor Project Apper- tions:

8. Work Animals ... 55.29

\$.10

9. Administration ... 124.75

.75

10. Maintenance ... 51.33

.12

11. Permanent

Improvements ... 118.64

.21

Total 412.71

Grand Total \$913.13

.75

\$1.28

APPENDIX.

Experimental beds are not included in the costs, since they are not included in estimates of stock on hand.

APPENDIX

Savenac NurseryCost DataSavenac NurseryCost DataCalendar Year 1915.Project 2Calendar Year 1915OperationHoursSecond Year

<u>Disbursements</u>			<u>Seed Beds</u>	<u>Cost per Bed</u>
Labor	\$277.04	56.62	Time spent on irrigation charge to Project 4.	
Merchandise	29.28			
Total	\$306.32	529		\$.58
Plowing	152	60.30	Time spent on irrigation charge to Project 4.	
Minor Project Appor-				
tionments:				
8. Work Animals ...	53.39			\$.10
9. Administration.	184.75	10.00		.35
10. Maintenance ...	61.93			.12
11. Permanent		15.24	Per plowing and harrowing ground	
Improvements..	113.64		Moving tables to	.21
Total	413.71			.78
Grand Total.....	\$720.03			\$1.36
Taking up				
Seedlings	473	178.36		
Uncovering				
Transplants	164	62.57	Caring for transplants covered	

Experimental beds are not included in the costs, since they are not included in estimates of stock on hand.

Total \$198 \$786.09

Total Transplanted 1,567,050. Actual cost of Transplanting \$.26.

Minor Project Apportionments:	Per M.
8. Work Animals	\$ 53.59... .08
9. Administration	184.75... .12
10. Maintenance	61.93... .04
11. Permanent Improvements	113.64... .07
	\$413.71 .26

Apportionment from Minor Projects per M. \$.26

Total Cost of Transplanting

\$1.36

Revised Summary

Cost Data

Project 2

Calendar Year 1915

Disbursements

Second Year
Beal Beal

Cost per Beal

Lebor \$277.04
Merchandise 29.28
Total \$306.32

522

\$.58

Minor Project Appor-

tions:

8. Work Animals ... 22.20
9. Administration 184.75
10. Maintenance ... 61.23
11. Permanent
Improvements 113.64
Total 412.71
Grand Total \$720.03

412.71
\$720.03

\$.10
.35
.12
.21

.73
\$1.36

Experimental beal are not included in the costs, since they are not included in estimates of stock on hand.

Savenac NurseryCost DataProject 3Calendar Year 1915.

<u>Operation</u>	<u>Hours</u>			
Transplanting.....	1075		\$385.15	Including threading and planting.
Foreman	135		55.62	Time spent on irrigation charged to Project 4.
Plowman	152		60.30	Time spent on irrigation charged to Project 4.
Horse	160		20.00	
Horse Feed			10.00	
Teamster	34		13.94	For plowing and harrowing ground. Moving tables to and from field.
Taking up				
Seedlings	473		178.26	
Uncovering				
Transplants	164		62.67	Caring for transplants covered by dirt from plow.
Hardware			.15	
Total	2193		\$786.09	

Total Transplanted 1,567,050. Actual cost of Transplanting \$.50.

Minor Project Apportionments:	Per M.
8. Work Animals	\$ 53.39... .03
9. Administration	184.75... .12
10. Maintenance	61.93... .04
11. Permanent Improvements	<u>113.64... .07</u>
	\$413.71 .26

Apportionment from Minor Projects per M. \$.26

Total Cost of Transplanting \$.76

Operation	Hours	
Transplanting.....	1075	\$286.15 including shading and plant
Foreman	135	 55.62 Time spent on irrigation chan
		to Project A.
Flowerman	152	 60.30 Time spent on irrigation chan
		to Project A.
Horse	160	 30.00
Horse Feed		 10.00
Teamster	24	 18.94 for plowing and harrowing and
		Moving tables to and from the
Seedlings	475	 178.25
Uncovering		
Transplants	164	 62.67 Oiling for transplants cover
		by first from glow.
Hardware		 12
Total		\$786.02
Total Transplanted 1,557,050. Actual cost of Transplanting \$1.		
Minor Project Apportionments:		
8. Work Animals	\$ 52.39	 03
9. Administration	184.75	 12
10. Maintenance	61.93	 04
11. Permanent Improvements	112.64	 07
	\$412.71	 26
Apportionment from Minor Projects per M. \$.		
Total Cost of Transplanting		

Savenac NurseryCost DataProject 4Calendar Year 1915

<u>Disbursements</u>	<u>Total M.</u>	<u>Cost per M.</u>
Labor	\$356.52	1,388
Equipment & Supplies	2.55	1,271
Minor Project Apportionments:		
8. Work Animals \$ 53.39		\$.04
9. Administration	184.75	.15
10. Maintenance	61.93	.04
11. Permanent Improvements	113.64	.08
Total	413.71	.16
Grand Total	\$770.23	.29
Improvements	113.64	.10
Total	413.71	.25
Grand Total	\$774.96	.30

Revenue Summary

Cost Data

Calendar Year 1915

Project A

Major Items

Total M.

Cost per M.

Labor \$556.82 1,375

Minor Project Apportionments:

8. Work Animals \$ 52.39

9. Administ. - 154.75

10. Maintenance 61.92

11. Permanent Improvements 115.44

Total 418.71

\$ 0.04

12

0.04

0.08

82

\$ 55

Grand Total \$770.23

Savenac NurseryCost DataProject 5Calendar Year 1915DisbursementsTotal M.Cost Per M.

Equipment & Supplies

\$ 2.55

1,171

Labor 258.45

Total \$261.15 \$ 0.23

Minor Project

Apportionments:

8. Work Animals 53.39..... \$.05

9. Administra-
tion 184.75..... .16

10. Maintenance 61.93..... .04

11. Permanent
Improvements 113.64..... .10

Total \$413.75 \$0.35

Grand Total \$674.86 \$0.58

Revenue Receipts

Cost Data

Calendar Year 1915

Project 5

Disbursements

Total M.

Cost per M.

Equipment & Supplies \$ 2.55
Labor \$28.48
Total \$31.03

Minor Project
Appointments:

8. Work Animals \$2.39 \$.02
9. Administration \$.15
10. Maintenance of \$.04
11. Permanent
Improvements \$13.64 \$.10
Total \$13.75 \$0.35
Grand Total \$44.86 \$0.58

Savenac NurseryCost DataProject 6Calendar Year 1915.Spring Stock Distribution

<u>Disbursements</u>	<u>No. of M. Shipped</u>	<u>Cost per M.</u>
Labor \$588.20		\$.30
Horse Hire 15.00	1,960	.01
Moss 49.50		.025
Shipping Crates. 34.53		.02
Total \$687.23		.35

Minor ProjectApportionments:

8. Work Animals 33.32		.017
9. Administra- tion 117.60		.06
10. Maintenance 39.20		.02
11. Permanent Im- provements 78.40		.04
Total 268.52		.14
Grand Total \$955.75		.49

Fall Stock Distribution.

Labor \$343.78	1,131	\$.30
Burlap 6.22		.005
Merchandise 9.11		.008
Total \$359.11		.31

Minor ProjectApportionments:

8. Work Animals 20.07		.017
9. Administra- tion 67.15		.06
10. Maintenance 22.73		.02
11. Permanent Im- provements 35.24		.04
Total 145.19		.14
Grand Total \$504.30		.45

Complete Total ... \$1,460.05 Average Cost per M. ... \$.47

TO

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