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3250 Forest Soil and Water Management
3230 Forestation and Tree Improvement

Siegel Pass Plantation Regeneration Study Plan

District Ranger, Ninemile RD

The following is a study plan that outlines the procedure for testing treatments and further analysis on regeneration problem areas in the upper Ninemile drainage. Detailed analysis is discussed in a January 5, 1984 (stamped 1983) letter to the District Ranger with same file designations as above.

INTRODUCTION

Ninemile RD has identified 271 acres of plantation in the upper Ninemile drainage that show one or more of the following regeneration problems: 1) low vigor in western larch saplings, 2) spotty seedling survival, and 3) sapling damage in lodgepole pine and subalpine fir from Armillaria spp. An additional 327 acres had similar site preparation treatment as the above acres and may have similar site problems.

During site preparation of these plantations, slash was piled by dozers when soil moisture was high. Scarification was very complete reducing fuels below recommended quidelines. Burning of windrows was very hot and soils were very dry.

Soil samples were collected from Stand No. 14-802 (plantation) mid-October, 1984. Results show a significant change in chemical properties of the soil and an increase in soil bulk density by 24 percent compared to a nearby unharvested site.

Consultation with Nellie Stark, Professor of Soils and Forest Nutrition Researcher at the University of Montana verified that soils tested were deficient in phosphorous, magnesium, and calcium. A transect in Stand No. 14-802 using observation of soil structure changes and water infiltration characteristics revealed that the extent of the effects of soil compaction is a slight to moderate problem. Overall, deficient nutrients appears to be the major soil factor contributing to stress on the site.

PURPOSE OF STUDY

The recommendation for treatment of these sites is to restore the deficient nutrients to the soil by the use of chemical fertilizer. Nutrient needs of conifers are not well understood and currently are undergoing research. Hence, treatment of these areas should be conducted initially as a test and results monitored for the most effective treatment. The specific objectives of this study are the following:

A. Test several fertilizer treatments on Stand No. 14-802 and select the treatment that gives the best response for recommendation for application to the rest of the plantation.

B. Analyze plantations for patterns of response that might improve our understanding of the relation of burning or equipment use on degradation of these sites.

1) This portion of the study will give us critical insight into what degree and extent our site preparation on these plantations resulted in regeneration problems and possible permanent site degradation. This will help in future site preparation recommendations.

2) Analyzing other plantations to test for similarities to Stand no. 14-802 to establish whether similar fertilizer treatments are necessary on these plantations.

METHODOLOGY

Objective A

In Stand no. 14-802, set up four permanent one acre plots. Each plot will include the range of variability that exists in the plantation. Two important inclusions will be the mixed stand of 10-12 year old lodgepole pine, Douglas fir, and western larch on approximately 35% slope and the swale area where seedling regeneration is very low.

Treatments are as follows:

PLOT 1 - control; no treatment. Maximum/minimum thermometer placed at two feet above ground level. At least 20 2-0 seedlings planted 8'x 8' in the area where seedling regeneration is very low.

PLOT 2 - 100 lbs/acre of phosphorus. At least 20 2-0 seedlings planted 8'x8' in the area where seedling regeneration is very low.

PLOT 3 - 100 lbs/acre of phosphorus + 20? lbs/acre of magnesium. At least 20 2-0 seedlings planted 8'x8' in the area where seedling regeneration is very low.

PLOT 4 - 100 lbs/acre of phosphorus + 20? lbs/acre of magnesium + 50? lbs/acre of calcium. At least 20 2-0 seedlings planted 8'x8' in the area where seedling regeneration is very low.

Treatment test plots shall be set up as soon as the snow melts in the spring and access to the site is available, expected at the end of May to mid-June.

Xylem sap will be collected ~~one month later~~ in mid-July for analysis of uptake levels of nutrients by the saplings. This analysis will be used as an indicator of plant response to the fertilizer treatments. This analysis should be done

RESULTS

A report summarizing results of this study will be drafted after the first year of observation. This report may then be used to select the appropriate action to be taken for treatment of the effected acres.

JONI SASICH
Soil Scientist

the following year to assure inclusion of one full growing season, especially early spring uptake.

Pre-treatment and post-treatment microbial activity will be measured to establish response by increasing availability of Ca, P, and Mg to microbes. This measure will relate to nutrient availability to plants. Also it may have some relation to the incidence of Armillaria in the stand, although this is speculative at the present.

Incidence and degree of tree damage by Armillaria pre-treatment and post-treatment will be documented. This should be done for ___ years following treatment.

Vigor of western larch will be documented during late growing season prior to leaf fall the first year and during growing season after the first year for ___ years.

Survival and vigor of planted 2-0 seedlings will be documented during late growing season the first year and for ___ years after.

The number of natural seedlings will be counted in three 1/100 acre-plots within each treatment test plot for the first three years.

A Maximum/Minimum thermometer placed at two feet above the ground will be read weekly in June,1984.

Objective B

Transects across all 3 plantations will be run and results plotted. Variables to be observed are the following:

1. Tree species and count
2. Tree height and approximate age
3. Overall tree vigor
4. Incidence of armillaria damage
5. Topographic position
6. Observable soil compaction and/or displacement
7. Amount and kind of fuels and duff on site
8. Understory height and vigor
9. Proximity to burned slash windrows

STUDY PARTICIPANTS

Al Christopherson, Forest Silviculturist
Ninemile RD representative, presumably Dave Griffin, District Silvicuturist
Joni Sasich, Soil Scientist
Nellie Stark, Professor of Soils and Forest Nutrients .esearcher, Univ. of Montana

Soil Analysis
Joni

United States Department of Agriculture | Forest Service | SO

Reply to: 3250 Forest Soil and Water Management
3230 Forestation and Tree Improvement

Date: JAN 5 1983

Subject: Siegel Pass Plantation Regeneration Study

To: District Ranger, Ninemile RD

Dave Griffin, Ninemile Ranger District Silviculturist, brought to my attention a regeneration problem which is occurring in several plantations in the Upper Ninemile Area. The problem is spotty survival of seedlings and incidence of timber damage from *Armillaria* spp. Also, in one unit (Stand No. 14-802), poor vigor in western larch saplings has been observed.

On October 13, Dave Griffin, Gretchen Merrill, and I surveyed the plantation (Stand No. 14-802) near Siegel Pass for indications of what is causing this negative response. Soil compaction was our primary concern. Soil samples for chemical laboratory characterization and compaction analysis were taken.

INTRODUCTION

The following information on past treatment of these sites was gathered from District records and Forest Service employees who were involved with the treatment of these plantations. Stand No. 14-802 was harvested sometime between 1969 to 1972. Slash was dozer-piled in large windrows in early fall and burned in the late fall of 1973. Soil moisture was high during slash-piling and approximately 50 percent scarification on the average was achieved. Some areas may have received as much as 80 percent scarification. Soils were dry during burning in late fall and the windrows burned hot. This plantation may have been seeded with an erosion control grass mix. There was a grazing allotment in this area, but there is some uncertainty to whether or not this site was grazed.

ANALYSIS

Soils are Holloway series. Characteristics of these soils are a volcanic ash mantle ranging from 18 to 25 centimeters in depth, very gravelly sandy loam subsoils, well drained, and have a cryic soil temperature.

Soil Compaction:

During the walk through on October 13, moderate to strong compaction was observed to a depth of 22 centimeters on 15 to 20 percent of the area. On one-third of the sites sampled, infiltration was severely impeded by compaction. Soil bulk density measured by the Saran method showed a 24 percent increase in density from the natural situation. Natural stand bulk density in the ash mantle is .77 g/cc3 and the average bulk density for the compacted ash surfaces in the plantation is 1.00 grams per cubic centimeter. Compaction studies on the Flathead National Forest have shown that soil bulk densities greater than .90 g/cc3 in volcanic ash soils reduce soil aeration and overall site productivity significantly.

Soil Chemical Characterization:

Soil chemical characterization shows several significant differences between the soils sampled from the natural stand which was the control and the soils sampled in the plantation. Complete results are shown on the following page in Table 1.

Soil Sample No. 3 was taken from a burned dozer-pile site where the soil was visibly damaged by fire. Results show significant changes in soil chemistry similar to what has been reported in the literature about alteration of soils as a result of extremely hot fires. There was a release of trace elements from the destruction of organic matter and melting of mineral soils. Bases, e.g., calcium, magnesium, potassium, have been reduced probably as the result of an initial release from burning and then subsequent leaching.

Aluminum, zinc, and copper content in Soil Site Nos. 2 and 4 are higher than the Control Site No. 1. Calcium, magnesium, potassium, and phosphorus in Site Nos. 2 and 4 are lower than the Control Site No. 1. According to Nellie Stark, Research Soil Scientist, University of Montana, the increase in zinc and copper is not significant and the amount of potassium remaining is adequate to support conifers. But, the increase in aluminum is significant and the amounts of calcium, magnesium, and phosphorus are very low.

DISCUSSION

Results show that the soils in Stand No. 14-802 have been severely altered. Both chemical and physical soil properties have been altered or degraded. The following are hypotheses of why we have a problem:

1. Compaction on 15 to 20 percent of the area alone is not enough to explain these results. Knowing the past treatment history of the area, it is probable that there could have been more compaction previously. Freeze-thaw may have broken up the surface of some compacted areas. Soil aeration may remain adversely effected after many freeze-thaw cycles. Reduction in aeration effects root growth and microbial environments.

A microbiological imbalance was created in the soil by a combination of poor aeration, removing too many fuels, and burning fuels hot when the soils were dry. The soil has not been able to recover because the fuels are not there to introduce new nutrients into the cycle. This in turn causes a soil chemical imbalance that we see today.

2. Burning windrows during dry soil conditions may have had more significance in extent of damage than previously assumed. Chemical changes in the soil shown by analysis are similar to those brought on by intense fire. We should look more closely for patterns of response in the regeneration to see if a relationship may exist. Patterns were not readily visible during the walk through in October.

3. In Stand No. 14-802, there appears to be only an occasional subalpine fir and spruce in the swale area at the southern edge of the unit, opposed to preponderance of lodgepole, larch, and Douglas-fir in the rest of the unit. This may be indicating a difference in microclimate or soil drainage. Laboratory characterization show only small differences in soil chemistry between these two sites. This leads me to believe some other factor besides the soil is causing this preference in regeneration.

TABLE 1: SIEGEL PASS PLANTATION (Stand No. 14-8-02) SOIL ANALYSIS (PARTS PER MILLION)

ELEMENTS	SITE NO. 1	SITE NO. 2	SITE NO. 3	SITE NO. 4
Aluminum	57.6	121.0	60.1	110.0
Boron	0.26	0.24	0.42	0.00
Calcium	1570.0	486.0	990.0	452.0
Copper	.75	1.56	2.14	1.01
Iron	57.7	44.7	43.6	79.1
Magnesium	124	38.8	79.4	70.0
Manganese	18.4	19.4	23.8	21.8
Mercury	.6	.4	.7	0.0
Potassium	330	150	290	260
Molybdenum	.09	.18	0.00	.09
Phosphorus	4.4	1.6	3.4	1.3
Sodium	11.6	21.5	24.0	15.0
Silcon	57.6	49.2	22.3	41.7
Zinc	.48	1.99	.36	.99
Titanium	.81	.74	.54	.78
TOTAL Nitrogen	1,340	1,470	660	1,720

Site Descriptions:

Site No. 1 - Control; taken from adjacent unharvested stand with a mixed overstory of preponderance of lodgepole pine with Douglas-fir and western larch. Landform and soils are similar to sites in plantation.

Site No. 2 - Site in plantation unit near a western larch sapling that exhibits poor vigor. Soil is moderately compacted.

Site No. 3 - Site in burned dozerpile. Thistle, fireweed, mountain brome, and pearly everlasting occupy the site. No conifer regeneration or native shrubs, i.e., pachystma, huckleberry, occupy this site.

Site No. 4 - Site is located in a low portion of the unit near the southern edge. Regeneration is poor. Subalpine fir and spruce are the only regenerating on the site.

The relationship of aluminum and other bases is a critical one. Imbalances can lead to poor growth response. The ratio of aluminum to calcium, magnesium, and phosphorus may be too high in Site Nos. 2 and 4. I believe that this chemical imbalance is contributing to the negative response we are seeing. Poor soil chemical characteristics can lead to an unhealthy soil microbial population, i.e., Armillaria and other pathogens. Also, trees that are under stress from nutrient deficiencies or toxicities will be more susceptable to pathogens.

There is also a strong relationship between aluminum and phosphorus in the soil. An imbalance can severely retard root growth and branching. Site Nos. 2 and 4 have critically low amounts of phosphorous, according to Nellie Stark, and the aluminum content is much higher than the control site. Poor vigor in the western larch saplings may be an indication of this nutrient imbalance.

RECOMMENDATION

When looking at corrective treatment for these plantations we must keep in mind that research is not conclusive to what nutritional needs a conifer has or their tolerance of "toxic" levels of certain elements. Nellie Stark who is researching nutrient requirements of temperate forest conifers has been helpful to suggest where problems may exist. Therefore, treatment of these areas should be conducted initially as a test and monitored for response.

I suggest treating small areas within each plantation with a combination of fertilizers, i.e., phosphorus, phosphorus plus magnesium, phosphorus plus magnesium plus calcium. Within these treatment areas, plant stock in areas of low stocking, then monitor their response. Nellie Stark is interested in monitoring response by xylem sap analysis which would give us results during the same growing season. Also, monitoring microbial response may show whether the microbial environment has been altered. Monitoring microbial activity within treatments along with the xylem sap analysis may allow us to separate tree versus microorganism response.

With favorable results, we could apply the treatment that offered the greatest response to the remainder of the units.

I believe this situation is one that will not correct itself naturally because the reduction of fuels was so complete. The sources for nutrient cycling have been depleted.

Joni Sasich
JONI SASICH
Soil Scientist

cc:
D. Griffin
A. Christopherson
J. Sasich

MESSAGE DISPLAY FOR THOMAS M. RICE

To t.rice

From: Marty Jurgensen
Postmark: Aug 22,97 12:11 PM Delivered: Aug 22,97 12:11 PM
Status: Confidential Previously read
Subject: Forwarded: Reply to: SOLO Information

Comments:
From: Marty Jurgensen:S22L04A
Date: Aug 22,97 12:11 PM
Tom, more stuff!! Glad you had a good fishing trip. In case you need to check another fishing hole - try thehun.com. Hope my trip to Utah will work out OK. You never know working at 10,000 feet!!
Cheers!!

Previous comments:
From: Wayne D. Barndt:R01F16A
Date: Aug 13,97 9:00 AM
1983 Regeneration Study - Stand No. 14-802
This was a grand fir/queencup beadlily
Typic Eutroboralfs, loamy skeletal, mixed, frigid
LTA is 60 and the LSI is 30QE which gives you the landtype, parent material and the landform.
This is in the Ninemile Creek Watershed
Fertilization Study
This is a douglas fir/blue huckleberry
Dystric Eutrochrepts, loamy skeletal, mixed, frigid
LTA is 62 and the LSI is 30GA which gives you the landtype, parent material and the landform.
This is in the West Lee Creek Watershed
Have the fellows ever called for the computer download from here?

Message:
From: Marty Jurgensen:S22L04A
Date: Aug 09,97 3:03 PM
Skip, I'm working with Tom Rice on getting some of the information, files, etc. you gave Tom to enter in the SOLO database. In the pile of various "stuff" I found memo's and information from: 1) a 1983 regeneration study at Siegel Pass (Stand No. 14-802), and a fertilization trial in the West Lee Drainage (1984). In order to enter this material we need: 1) habitat types, 2) soil classification (family level), 3) LTA's, 4) Landtypes, 5) parent materials, 6) landform, 7) Watershed, 8) position on the landform/topography. These are all listed on the SOLO monitoring report form. We will probably be "bothering" you again as more of the Lolo NF information

---------------X---------------

5-4-84
D.E.

Siegel Pass Larch Xylem Sap Analysis

Sample	Poor #1	Poor #2	Natural #1	Natural #2	
Al	6.80	7.58	3.26	3.01	Big Diff.
B	.28	.31	.31	.19	
Ca	16.6	19.2	22.1	25.1	Higher
Cu	.65	.53	.58	.52	
Fe	.16	.28	.31	.22	
Mg	11.2	8.58	10.6	9.95	± = 9.9 10.2
Mn	2.50	3.26	3.07	3.01	Sl. ↑
Mo	0	0	0	0	
P	34.0	46.1	27.9	39.3	Sl ↑
Na	.29	.22	.23	.26	± = same
Si	6.27	3.02	14.6 ?	5.83	↑
Zn	.30	.30	.51	.29	
K	69.3	85.6	67.8	94.6	?
N	190.0	189.4	262.2	256.8	S ↑

Too few samples for drawing conclusions, but looks like the trees are compensating for low soil Mg r P by growing more root, less top. Added N could help some.

N. Cleange A. Stark