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A Forest Fertilization Study for the Inland Empire[1]

by H. Loewenstein and F. H. Pitkin[2]

It is becoming increasingly apparent that in the future, timber production will be concentrated on a smaller land base than heretofore. Of necessity, foresters will be forced to maximize yield on these lands devoted to intensive management. One possible way to increase production is through adoption of fertilization programs. With the exception of nursery management, this technique has not been employed extensively in forestry. Recent research in various parts of the world, however, has revealed that important growth increases may come about through the addition of particular nutrients to the soil. A great deal of pertinent information concerning the subject may be found in the volume entitled *Forest Fertilization: Theory and Practice,* published by the T.V.A. in 1968.

Although it is now well documented that trees *can* respond to fertilization treatment, the forest manager cannot tacitly assume they *will* respond in his particular situation. Extensive forest fertilization programs demand an impressive initial expense, and cannot be entered into blindly. Because of this, experimental programs designed to test the fertilizer responsiveness of particular species growing in particular environments are underway in various parts of the United States (e.g., Regional Forest Nutrition Project, western Washington and Oregon; Cooperative Research in Forest Fertilization, Florida). Such a program has now been established for Northern Idaho, and is described below.

The current University of Idaho Forest Fertilization project developed after earlier research produced encouraging results. At Ramskull Creek (near Emida, Benewah County), for example, an application of 150 lbs/acre nitrogen almost tripled the growth rate of 15-year-old grand fir *(Abies grandis* [Dougl.] Lindl.) growing under the canopy of an offsite ponderosa pine *(Pinus ponderosa* Laws) plantation (Loewenstein and Pitkin, 1963). In a second experiment, conducted on the Flat Creek Unit of the University of Idaho Experimental Forest, an application of 300 lbs/acre nitrogen, 150 lbs/acre phosphorus, and 150 lbs/acre potassium more than doubled the diameter growth of 25-year-old grand fir during the 3-year period following fertilization (Loewenstein and Pitkin, 1971). Response of Douglas fir *(Pseudotsuga menziesii* [Mirb.] Franco.), while not as dramatic, was still appreciable. The great gain in fiber production overshadowed the small decrease in specific gravity resulting from treatment in these experiments. Although the study at Flat Creek employed phosphorous and potassium as well as nitrogen, results of the Ramskull Creek experiment as well as other unpublished work clearly show the dominant influence of nitrogen. This element was selected for the extensive investigation detailed in this paper.

Study Description

Response of grand fir and Douglas fir is being investigated in this work because 1) earlier experiments showed they had the ability to respond to additional nitrogen, and 2) interested foresters in the area desired more definitive information concerning these two species. Present financial considerations preclude experiments with other native species but in the future it is hoped that their response will be assessed also.

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[2]Professors of Forestry

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For purposes of this study, that portion of Idaho north of the Salmon River has been subdivided into 3 major units, based on the character of the underlying rock. These subdivisions include (1) Tertiary granitic rocks and granitic rocks of the Idaho Batholith, (2) Columbia River basalt, (3) Belt series of metamorphosed sediments. Within the 3 units, plots are being established in stands of Douglas fir and/or grand fir. Stands representing 2 general age classes, 15 to 35 years, and 35 to 60 years are involved. Site selection has comprised one of the most critical phases of the entire project. Unless the stands selected truly represent widespread conditions, the prediction value of experimental results will be reduced.

Personnel from both private corporations and public agencies have been asked to suggest possible plot locations. Information concerning suggested sites is recorded by these cooperators on standard forms. Final selection is made by the project leaders after personal inspection of sites deemed likly to be satisfactory.

A general description of salient features of the site and associated vegetation is made at the time of plot establishment. A complete soil profile description will be made at each site. In addition, surface soil samples will be collected and analyzed for pH, nutrients, organic matter, texture, moisture relations, etc., to more completely characterize the soil.

Twelve installations are being made on each rock type, 3 for each of the 4 species-age class combinations. An installation consists of 8 plots. Two of these plots serve as controls, 2 others are fertilized with urea at a rate of 200 lbs/acre nitrogen, no other treatment being given. The remaining 4 plots are being used to assess the influence of thinning on fertilizer response. These plots are thinned to about a 15-foot spacing. Two thinned plots receive no further treatment, the other 2 are fertilized similarly to the unthinned plots. The rate of 200 lbs/acre nitrogen was chosen after assessment of results from the preliminary work mentioned earlier. Fertilizer is spread as evenly as possible by means of cyclone spreaders. Size of individual plots is 1/10 acre, and each plot is surrounded by a buffer strip which is treated in the same manner as the plot itself. Measurements will only be made on trees within the plot boundary.

Before fertilization, all stems over 2 inches DBH (diameter at breast height) are tagged and initial measurements are recorded. Height measurements are made for 5 dominant or co-dominant trees per plot. From these, the site index is found. The figures also serve as the initial readings for determination of height response.

The first series of plot remeasurements is to be made at the conclusion of the second growing season after treatment. DBH of all trees previously recorded will be remeasured. The major series of plot remeasurements will be made after 4 growing seasons have elapsed. By this time, any height differences resulting from treatment should be large enough for accurate determination. As indicated above, because of the time-consuming nature of height determinations, these measurements will be restricted to 5 trees per plot. DBH will again be found for all trees previously measured. At the time of these remeasurements, increment borings will be obtained from the trees utilized for height determinations. These will be used to obtain a record of annual diameter growth for the 4-year period immediately prior to treatment as well as annual growth during the subsequent period. These data are needed to determine if possible differences in tree growth are actually due to treatment, or whether some environmental difference between plots is responsible for the dissimilarity.

The possible influence of treatment on wood quality will also be subject to scrutiny in this study. From the increment borings, data will be secured concerning percent early wood, percent late wood, and specific gravity.

Nitrogen levels in the foliage tissue of representative trees from each plot will be determined at the conclusion of each growing season as standard practice. Additionally, changes in nitrogen levels of foliage during the growing season will be assessed on selected sites. More nutritional aspects will be considered if financing permits.

All data are being collected in a manner which promotes rapid computer analysis of statistical significance. The use of the computer is mandatory, as some 30,000 individual trees are subject to at least certain measurements. As results accumulate, cooperators and others interested in the work will be kept informed of results through periodic progress reports, as well as formal publications.

Proposed Supplementary Studies

While the main thrust of this work is concerned with growth response of Douglas fir and grand fir, treatment may also produce other effects of consequence. For example, the nutritional status of the trees as it affects susceptibility to attack by insects and pathogenic microorganisms might be a fruitful subject for investigation on these plots. Secondly, fertilization could have a profund influence on subordinate vegetation, augmenting the forage supply of big game and domestic livestock and improving the habitat for wildlife. These plots would lend themselves very well to a study of this aspect.

Cooperators

This forest fertilization investigation is truly a cooperative project. With the limited direct financing available, contributions of one sort or another from outside sources were essential, and have been forthcoming to a gratifying degree. Installations have been established on lands of Inland Empire Paper Company, Milwaukee Land Company, Pack River Company, Potlatch Forests, Inc., Reggear and Sons, Orofino, Idaho, the State of Idaho Department of Public Lands, and the United States Forest Service. In most instances, these landowners have found it possible to perform the required thinning operations at their own expense, which has been an invaluable aid to the project. All the necessary urea fertilizer has been donated by Cominco American, Inc., and Shell Chemical Co. In addition, Phillips Petroleum Co. has made a monetary contribution. The Soil Conservation Service will aid in classifying the soils of the various installations.

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Installations

Following is a list of project installations as of June, 1972. At that time, 30 sites had been treated. The remaining 6 installations were to be found during the summer of 1972. Treatment of these was scheduled for the spring of 1973. Figure 1 shows the location of each of the installations already completed. Numbers on the map are keyed to plot numbers given in the list.

GRANITIC UNDERLYING ROCK

Douglas-fir – Age class 15-35
1. Blanchard–Inland Empire Paper Co.
2. Bridge Ck.–U.S.F.S. (Kooskia R.S.)
3. Spring Ck.–Idaho Dept. of Public Lands

Douglas-fir – Age class 35-60
4. Carr Ck.–Pack River Co.
5. Fan Ck. Rd.–U.S.F.S. (Kamiah R.S.)
6.

Grand fir – Age class 15-35
7. Hidden Ck.–U.S.F.S. (Clarkia R.S.)
8. Neva–U.S.F.S. (Potlatch R.S.)
9. Hildebrand–Potlatch Forests, Inc.

Grand fir – Age class 35-60
10. Bovill 1–Potlatch Forests, Inc.
11. Bovill 2–Idaho Dept. of Public Lands
12.

BASALTIC UNDERLYING ROCK

Douglas-fir – Age class 15-35
13. Orofino–Reggear and Sons
14. Caribel 1–Idaho Dept. of Public Lands
15. Dent–Idaho Dept. of Public Lands

Douglas-fir – Age class 35-60
16. Woodrat 1–Idaho Dept. of Public Lands
17. Cedar Loop–U.S.F.S. (Fenn R.S.)
18.

Grand fir – Age class 15-35
19. Poorman Ck.–Idaho Dept. of Public Lands
20. Weippe–Potlatch Forests, Inc.
21. Caribel 2–Idaho Dept. of Public Lands

Grand fir – Age class 35-60
22. Woodrat 2–Idaho Dept. of Public Lands
23. Santa–Idaho Dept. of Public Lands
24.

METAMORPHIC UNDERLYING ROCK

Douglas-fir – Age class 15-35
25. Shoshone Saddle–U.S.F.S. (Magee R.S.)
26. Quartz Mountain–U.S.F.S. (Falls R.S.)
27.

Douglas-fir – Age class 35-60
28. Berry Ridge–U.S.F.S. (Bonners Ferry R.S.)
29. Trout Ck.–U.S.F.S. (Trout Ck. R.S.)
30. Spades Mountain 1–U.S.F.S. (Fernan R.S.)

Grand fir – Age class 15-35
31. Copper Ck.–U.S.F.S. (Kingston R.S.)
32. Cats Spur–U.S.F.S. (Clarkia R.S.)
33.

Grand fir – Age class 35-60
34. Emerald Ck. – Milwaukee Land Co.
35. Spades Mountain 2–U.S.F.S. (Fernan R.S.)
36. Crystal Ck.–Idaho Dept. of Public Lands

Aerial Fertilization Trial

The College of Forestry, Wildlife and Range Sciences is cooperating in a trial of aerial fertilization being conducted by the State of Idaho Department of Public Lands. Three forested areas dominated by grand fir and Douglas fir and ranging from about 100 to 200 acres, are involved in the project. The urea fertilizer will be flown on by helicopter, the rate of application being the same as in the main study outlined above. College personnel will establish plots within and immediately adjacent to each of the treated areas and monitor them for possible growth responses. Additionally, water quality of streams flowing through the treated areas will be closely examined for any deleterious changes.

LITERATURE CITED

Loewenstein, H. and F. H. Pitkin. 1963. Response of grand fir and western white pine to fertilizer applications. Northwest Science 37:23-30.

Loewenstein, H. and F. H. Pitkin. 1971. Growth responses and nutrient relations of fertilized and unfertilized grand fir. FWR Exp. Sta. Station Paper No. 9. 16 pp.

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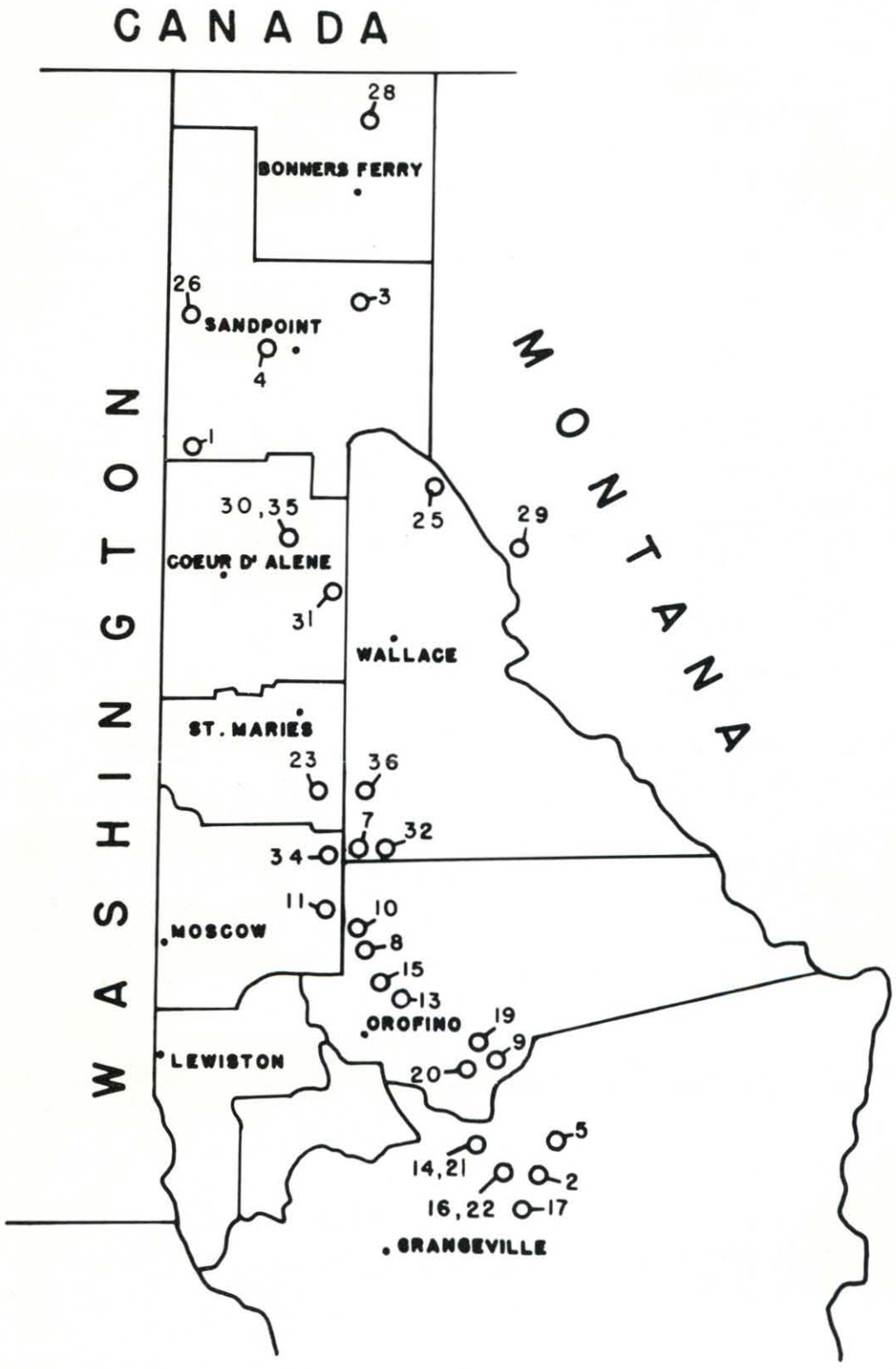

Figure 1. Map of northern Idaho showing location of the 30 installations selected by June, 1972. A key presented in the text identifies each installation.