



U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
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Research Note

EDITOR'S
FILE COPY

Number 105

Portland, Oregon

November 1954

SOIL REACTION AND GERMINATION OF DOUGLAS-FIR SEED

By

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Wood ash and its accompanying alkalinity have sometimes been cited as being harmful to germination of tree seed on slash-burned forest land. Unasylva, the United Nations forestry publication, recently carried a report of research in British Columbia on the effect of slash burning on germination and initial survival of lodgepole pine and Douglas-fir.^{1/} One finding was that "There was no germination where ash was added to unburned soil, due to the increased pH of the soil, the hardening of the ash layer, and exclusion of oxygen and high concentration of the nutrient solution."

In contrast, experiments at the University of Washington^{2/} indicate that Douglas-fir seed germinated successfully under controlled pH conditions ranging from strongly acid to strongly alkaline.

These contradictory reports prompted the inclusion of further tests in our program of research on the effects of slash burning on soil and regeneration.

^{1/} Silviculture: Canada. Unasylva 6 (1): 40. March 1952.

^{2/} Thrupp, A. C. Effect of seed-ash characteristics and treatment of seed and soils upon coniferous seed germination. Unpublished doctoral dissertation, University of Washington. 327 pp. 1939.

The Tests

Tests to determine the effect of soil pH on germination of Douglas-fir seed were performed in 1953 in three different media.

Artificially Heated Soils

Samples of soils that had been subjected to high temperatures were used as germinating media. These soils had a pH range from 4.5 (strongly acid) to 8.8 (strongly alkaline), according to the length of time and intensity to which they had been heated.^{3/} One hundred Douglas-fir seeds, all from the same lot and well mixed, were planted in the surface of each of the soils. When cotyledons of the germinated seeds were well formed, the seedling was tallied and removed from the soil.

Figure 1-A shows the ranges in soil reaction and seed germination. By chance, both the lowest and highest germination rates were obtained in soils of pH 5.5, with other pH values and germination rates scattered in no definite pattern. The range of germination in this test is typical of that found generally for Douglas-fir seed.

Ash-Sand Mixture

A mixture of fine Douglas-fir and western hemlock ash with sharp sand was used as the germinating media. A specially designed germinator apparatus was used to avoid surface puddling. This consisted of a porous irrigator flask buried in the germinating media, assuring a constant supply of water at about field moisture capacity without surface disturbance. Tests were made of seed germination in five different ash-sand mixtures. These mixtures contained the following percent of ash by weight: 0, 25, 50, 75, and 100. In pH, these mixtures ranged from 9.8 for pure ash to 6.8 for the pure sand.

The surface of each germinator was divided equally. In one half, seed was planted barely covered. In the other half, seed was planted one-half inch deep. Each treatment was replicated, and the individual germinators were randomly placed where all received full daylight.

Figure 1-B shows results of this test. Germination rates were considerably lower than might be expected for Douglas-fir seed under normal germination test conditions. The effect of oxygen restriction

^{3/} Tarrant, Robert F. Effect of heat on color and pH of two forest soils. Pacific Northwest Forest and Range Experiment Station, Research Note No. 90, 5 pp. October 1953.

is shown in the very low germination rates for seeds planted one-half inch deep, a common result of deep planting in any media. The comparatively high germination rate in the deep planted seeds in pure sand (pH 6.8) reflects better aeration conditions when the fine ash was omitted, thus preserving large pore space. Despite these differences, no relationship between soil reaction and germination was indicated.

Soils From Slash-Burned Areas^{4/}

Soils from areas that had been slash burned were used as germinating media. Samples of soil of various burn classes were taken in place in steel cylinders of approximately 8 inches diameter. On the surface of each cylinder, 100 Douglas-fir seeds were sown, and germination tallies were made.

Figure 1-C shows the results of this test. The coincidence of the four pH values above 7.0 with lowest germination rates is not statistically significant and must be considered a matter of chance.

Discussion

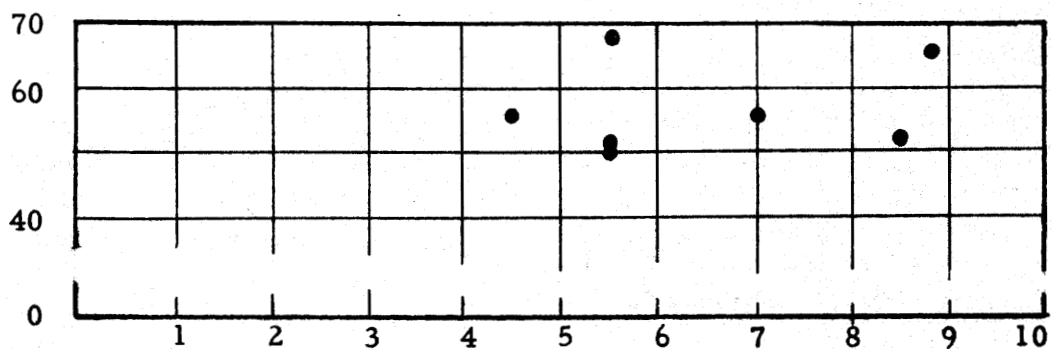
Three independent tests showed no relation between soil reaction and germination rate of Douglas-fir seed. The fact that a seed may germinate under a great variety of pH conditions does not necessarily mean that further growth will also be satisfactory. These tests do indicate, however, that high pH, within limits found after slash burning,^{5/} does not prevent germination of Douglas-fir seed.

An interesting sidelight of the ash-sand study was the disclosure that seedlings in the media of higher pH suffered heavy damping-off losses a day or two after emergence. It has long been established that near-neutral or alkaline soil reaction favors the development of damping-off organisms.^{6/} This suggests that preemergence damping-off may be responsible for the low germination rates in the ash-sand study. Further tests of the relation between soil reaction and damping-off under field conditions are now in progress.

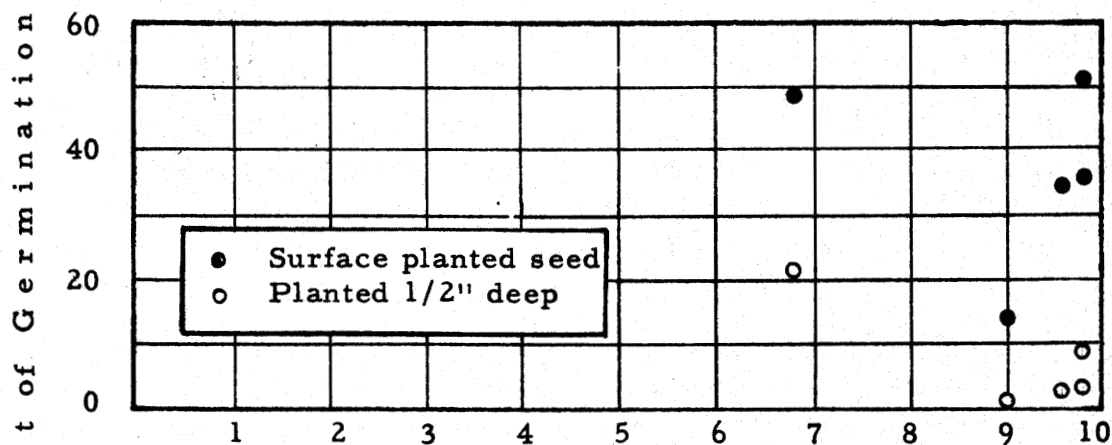
^{4/} This test is part of a cooperative study by the Pacific Northwest Forest and Range Experiment Station and the College of Forestry, University of Washington. Full credit is given Dr. Stanley P. Gessel and his staff for performing the greenhouse and laboratory work.

^{5/} Tarrant, Robert F. Effect of slash burning on soil pH. Pacific Northwest Forest and Range Experiment Station, Research Note No. 102, 5 pp. July 1954.

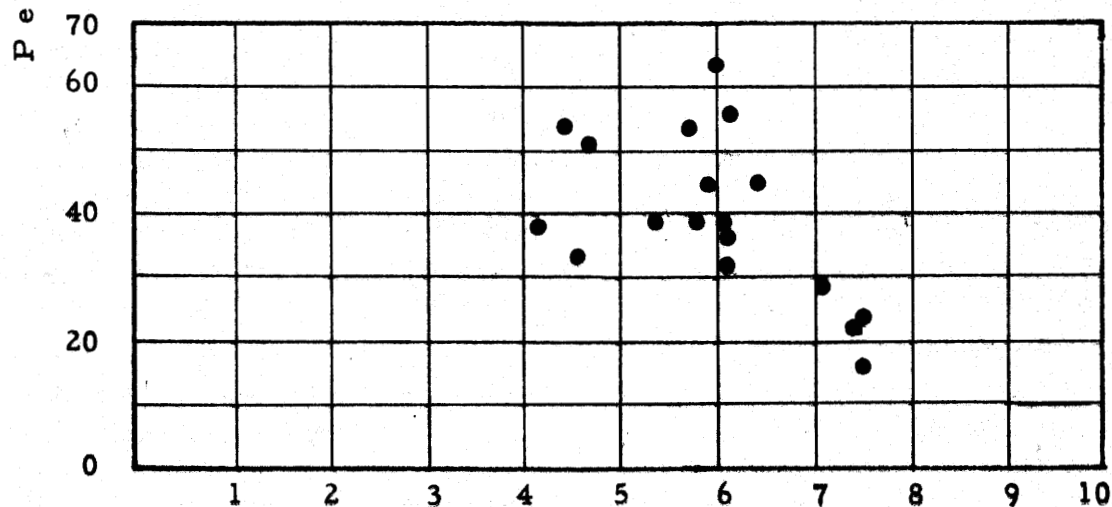
^{6/} Lutz, Harold J., and Robert F. Chandler, Jr. Forest soils. 514 pp. John Wiley & Sons, New York, N. Y. 1946.



A. ARTIFICIALLY HEATED SOILS



B. ASH-SAND MIXTURE



C. SOILS FROM SLASH-BURNED AREAS

pH

Figure 1. --Relation of seed germination to pH in three different germinating media.