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MICROBIOLOGICAL SOIL PROPERTIES AFTER LOGGING AND SLASH BURNING

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Considerable study has been made of the effects of logging and slash burning on chemical and physical properties of forest soils. However, little is known of the effect of such operations on microbiological properties.

As a preliminary step toward defining the problem, this exploratory study was made on a logged and slash-burned portion of the Marys Peak area in the Coast Range near Corvallis, Oreg. Four factors were of particular interest: (1) Soil reaction, a good general indicator of severity of burning;[1/] (2) bacteria and (3) fungi, which play important roles in soil life processes, and (4) actinomycetes, which form a taxonomic link between bacteria and fungi and are of equal ecological importance.

METHODS

The area selected for study had been logged and the slash burned in October. The following May, duplicate soil samples were

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1/ Tarrant, Robert F. Effects of slash burning on some soils of the Douglas-fir region. Soil Sci. Soc. of Amer. Proc. 20(3): 408-411, illus. 1956.

collected nonaseptically in 3- by 3-inch metal cylinders at two depths in the soil: 0-1.5 inches and 1.5-3 inches. These two depths will hereafter be referred to as "upper" and "lower." Three surface soil situations were sampled: Unburned, lightly burned, and severely burned. Texture of the soil was clay loam.

Each soil sample was analyzed in duplicate dilutions. Potato dextrose agar (pH 3.9) was used as a medium for determining numbers of fungi. Sodium albuminate agar (pH 7.2) was used for determination of bacteria and actinomycetes. Predominant genera of fungi were identified, and soil reaction was measured with a glass electrode.[2/]

RESULTS

Soil Reaction (pH)

The upper surface soil became less acid with increasing intensity of burning (table 1), as has been shown previously for similar soils of the Douglas-fir region.[3/]

At the lower depth, there was no real difference in pH between unburned and lightly burned soil. However, severely burned soil was significantly less acid than unburned soil.

Reaction of unburned soil was not different between the two depths sampled. In lightly burned and severely burned samples, however, soil was significantly less acid at the upper level.

Numbers and Ratio of Soil Bacteria and Actinomycetes

In unburned or lightly burned soil, no real difference in numbers of bacteria or of actinomycetes was found, either between the two degrees of burn or between the two depths sampled. Under severely burned conditions, however, numbers of bacteria and of actinomycetes were increased significantly over those in unburned or lightly burned soils at both depths. Moreover, numbers of bacteria

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2/ Analyses and identification of organisms were made by Dr. K. C. Lu, Department of Bacteriology, Oregon Agricultural Experiment Station, Corvallis.

3/ See footnote 1.

Table 1.--Soil reaction and numbers of micro-organisms in soils of a logged and slash-burned area

Depth sampled (inches) and soil burn class	Soil reaction	Micro-organisms (Thousands per gram of oven-dry soil)			Ratio: Bacteria to actinomycetes
		Fungi	Bacteria	Actinomycetes	
	pH	---------Number---------			
0-1.5:					
Unburned	5.68	69	2,910	676	4
Lightly burned	6.30	31	4,155	1,071	4
Severely burned	6.88	38	119,500	3,865	31
1.5-3:					
Unburned	5.68	56	1,390	357	4
Lightly burned	5.86	46	2,235	458	5
Severely burned	5.96	23	65,200	1,887	34

and of actinomycetes in the upper sample of severely burned soil were significantly greater than those in the lower sample of the same burn class. These findings also suggest that the greatest effect of burning is exerted in the uppermost part of surface soils.

The ratio, bacteria to actinomycetes, also increased sharply in severely burned soil. A reason for the great proportional increase in bacteria is not apparent, since other investigators have found that the occurrence of actinomycetes is governed by about the same conditions as those which affect bacteria.4/

4/ Lutz, Harold J., and Chandler, Robert F., Jr. Forest soils. 514 pp., illus. New york. 1946.

Number of Fungi

Compared with unburned soil conditions, lightly burned soil contained significantly fewer fungi at the upper level sampled. There was no real difference between lightly and severely burned soil in number of fungi at the same depth.

At the lower depth, no real difference was found between number of fungi in unburned and lightly burned soil. Severely burned soils, however, had significantly fewer fungi than either of the other two burn classes.

These data, again, indicate that effects of fire on soil are mainly restricted to the uppermost part of the surface soil. Both light and severe burning affected the number of fungi at the upper depth, but only severe burning penetrated below 1.5 inches in the soil to influence number of fungi at the lower sampling level.

The most common genera of molds identified in unburned soil samples were Penicillium, Trichoderma, Rhizopus, Mucor, Mortierella, Fusarium, Aspergillus, Stemphylium, and Pythium. Soil from lightly burned areas had a similar range of genera except that Fusarium was less common and, in addition, Botrytis, Hormodendrum, Gliocladium, and Cladosporium were observed. Samples of severely burned soil contained no Aspergillus; Fusarium and Stemphylium were more rarely observed than in lightly burned soil whereas Botrytis and Hormodendrum were somewhat more common. The significance of differences in mold genera between different intensities of soil heating has yet to be determined.

SUMMARY

An exploratory study was made of certain microbiological properties of the soil on a logged and slash-burned area in the Douglas-fir region.

Soil reaction was shown to increase generally with increasing intensity of burn. In severely burned soils, pH was significantly higher at the immediate soil surface than at a depth of 1.5-3 inches, indicating fire had little effect on soil at the latter depth.

Numbers of bacteria and actinomycetes were greatly increased in severely burned soils. The ratio, bacteria to actinomycetes, was also significantly raised in the same samples.

Numbers of fungi in lightly burned and severely burned soils were less than in unburned soils at the immediate soil surface. At a depth of 1.5-3 inches, severely burned soils contained fewer fungi than soils of either of the other two burn classes.

Findings suggest generally that burning had the greatest effect on microbiological activity in the uppermost part of the surface soil. Intensity of burning was shown to be important in determining whether or not microbiological properties of the soil were altered. In most cases, unburned and lightly burned soils were not greatly different in numbers of organisms or ratio of bacteria to actinomycetes. In contrast, marked changes were noted in the microbiological population of severely burned soils.