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OCCURRENCE OF MYCORRHIZAE AFTER LOGGING AND SLASH BURNING IN THE DOUGLAS-FIR FOREST TYPE

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EDITOR'S
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The association of certain fungi with plant roots results in formation of an organ called a mycorrhiza. There are two principal types of mycorrhizae: those with the fungus confined internally in the root, or endotrophic mycorrhizae, and those with both internal fungus development and an external fungal mantle enveloping the root tips, or ectotrophic mycorrhizae. Intergradation between the two types may also occur.

Ectotrophic mycorrhizae are of primary importance in forest-tree root systems and may be recognized as a mantle of fungal hyphae covering the short roots. Mycorrhizal fungi are principally aerobes and are therefore found in greatest numbers in the upper part of the soil.

The role of mycorrhizae has been investigated by many workers, who have found generally that the organ has a favorable influence on plant growth. The beneficial effect of mycorrhizae is considered to come partly from its action in assisting the plant to absorb nutrients. In effect, mycorrhizae greatly increase the absorbing surface of the root system, thus helping the plant make fullest use of its environment.

Certain physical, chemical and microbiological properties of the soil have been considered in studies of the effects of logging and

slash burning in the Douglas-fir forest type.^{1/} Within this program of investigation it was considered important also to determine whether or not usual slash disposal practices affect the occurrence and distribution of mycorrhizal development on tree seedlings. In particular, it was desired to determine whether relative severity of burn, which governs changes in certain soil properties after slash burning, is associated with occurrence of mycorrhizae. The effect of mycorrhizae on seedling growth was also a matter of interest.

METHOD OF STUDY

At each of two different locations, two clear-cut plots were studied in late spring, 1 and 2 years after burning. Each plot was 15 to 20 acres in size.

One pair of plots was selected on the H. J. Andrews Experimental Forest, which is located 45 miles east of Eugene, Oreg. These plots are situated at an elevation of approximately 2,700 feet. The other pair of clear-cut plots was selected on the Wind River Experimental Forest located about 20 miles north of the Columbia River in south-central Washington. These plots lie at an elevation of about 2,500 feet. Both study areas are on the west slope of the Cascade Range in forests typical of the old-growth Douglas-fir type.

The soil on the H. J. Andrews Experimental Forest study area is a sandy clay loam, while that on the Wind River plots is a clay loam. Both areas sampled contained severely burned, lightly burned, and unburned soil conditions.

Natural Douglas-fir seedlings, 1 and 2 years old, were dug and the soil carefully shaken from their roots. Examination was then made with a hand lens or microscope to determine presence or absence of ectotrophic mycorrhizae and the depth of first occurrence. Top and root length of each seedling was recorded, and soil samples were collected from the surface 1-1/2 inches for pH determinations. All seedlings that could be found on the study areas were examined.

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

RESULTS

Occurrence of Mycorrhizae

On the Wind River Experimental Forest study areas, presence or absence of mycorrhizae was found to be related to degree of burn for both 1- and 2-year-old seedlings (fig. 1). On lightly burned soils, the percentage of seedlings with mycorrhizae was significantly less than on unburned areas. In turn, there were proportionately fewer mycorrhizal seedlings on severely burned than on lightly burned areas. Under all soil conditions studied, mycorrhizae were present on a larger percentage of 2-year-old than 1-year-old seedlings.

At the H. J. Andrews Experimental Forest, a greater proportion of seedlings with mycorrhizal roots was found on unburned soils than on either lightly or severely burned areas. There was no real difference however in the ratio of mycorrhizal seedlings on lightly burned and severely burned soil. Again, as at Wind River, in all soil conditions studied a greater proportion of 2-year-old seedlings had mycorrhizal roots than in the 1-year-old group.

Seedlings with roots imbedded in decayed wood usually lacked mycorrhizae, as did seedlings growing on very rocky or compacted soil. The proportion of seedlings growing under such conditions was about the same on burned and unburned plots.

Depth of Occurrence of Mycorrhizae

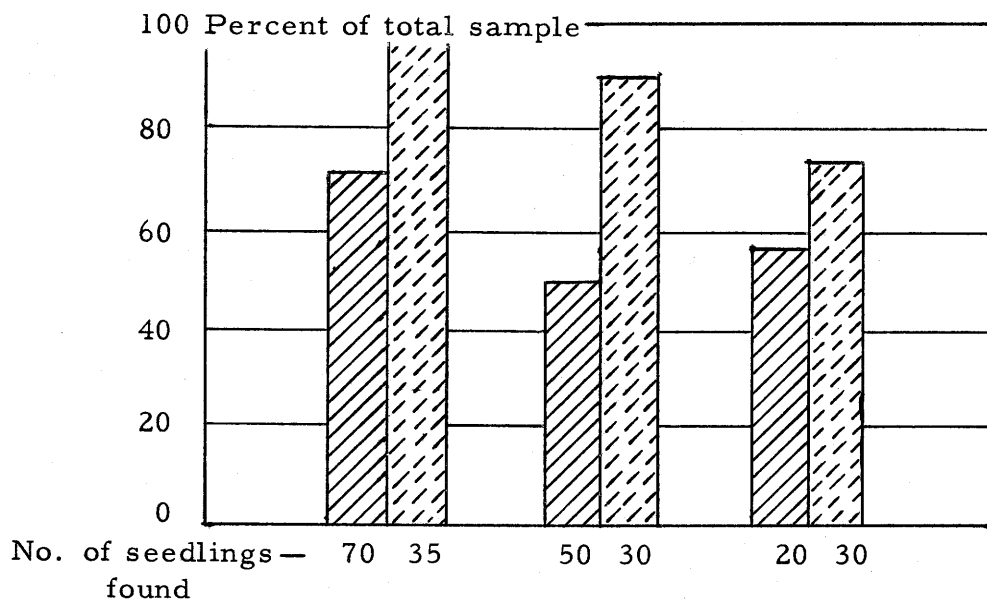
For 1-year-old seedlings at both study areas, depth of occurrence of mycorrhizae on seedling root systems was related to intensity of burn. In all cases, the more intense the burn, the deeper in the soil was the first occurrence of mycorrhizal growth (fig. 2).

Examination of 2-year-old seedlings, however, revealed no real difference in depth of mycorrhizal occurrence under any of the several conditions studied. Evidently, 2 years of soil weathering after the burn was sufficient to ameliorate conditions that previously had discouraged mycorrhizal development on seedling roots in the upper part of the soil.

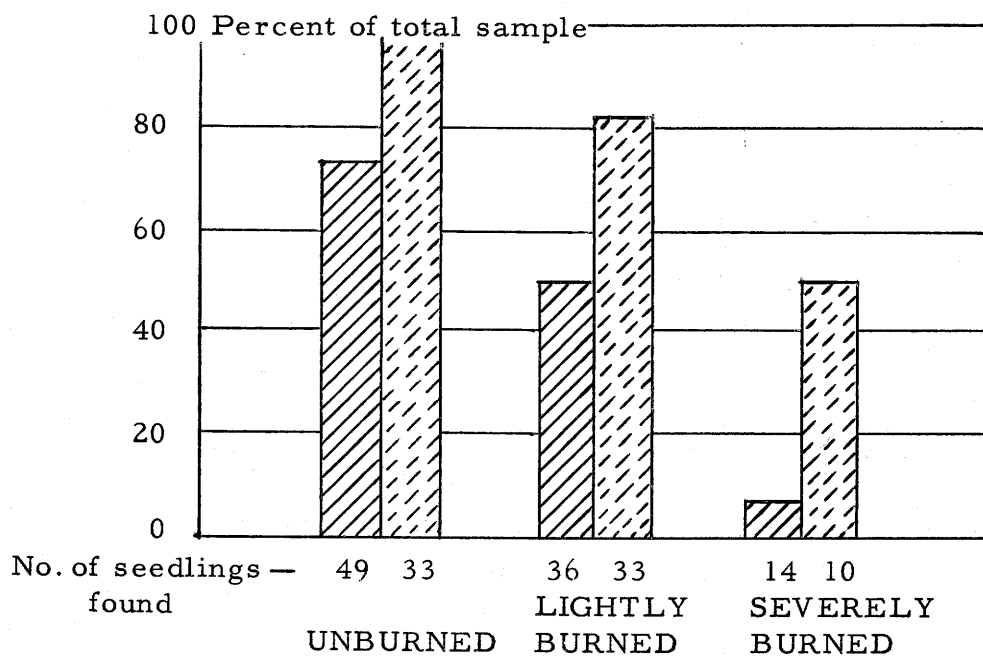
Seedling Growth

There was no significant difference, either in top or root length,

H. J. ANDREWS EXPERIMENTAL FOREST



WIND RIVER EXPERIMENTAL FOREST

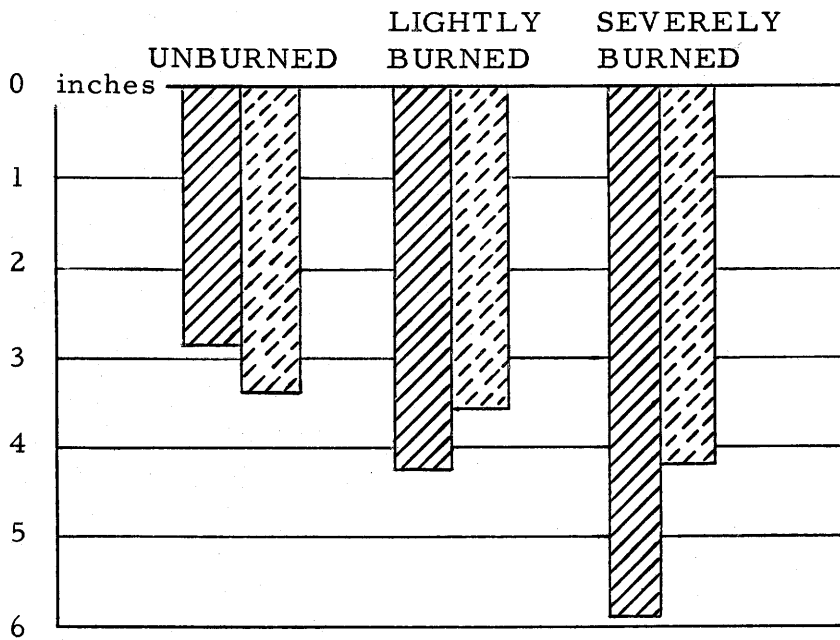


1-year-old seedlings

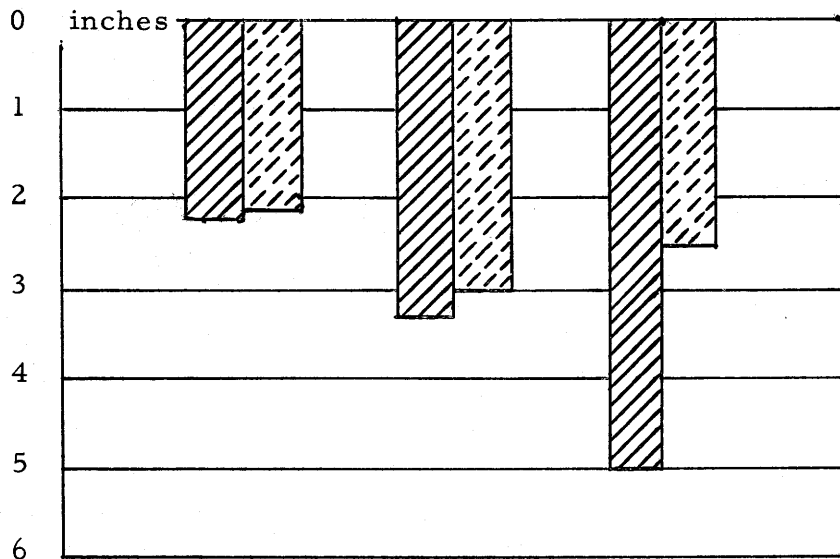


2-year-old seedlings

Figure 1. --Proportion of natural seedlings with mycorrhizal roots on unburned, lightly burned, and severely burned soil.



H. J. ANDREWS EXPERIMENTAL FOREST



WIND RIVER EXPERIMENTAL FOREST



1-year-old seedlings



2-year-old seedlings

Figure 2. --Soil depth at which mycorrhizae were first noted on roots of seedlings on unburned, lightly burned, and severely burned soil.

between seedlings with mycorrhizal roots and those without. However, any possible effect of mycorrhizae in increasing nutrient absorption was confounded with the effect of different degrees of burning, which also influences availability of nutrients in the soil.

Additional Factors

Abundance of mycorrhizae was evaluated for the entire root system of each seedling according to a numerical rating. No difference in abundance was found between the several burn classes. However, the subjective nature of this phase of the study makes any definite conclusion of doubtful value.

The mycorrhizae varied in color. A majority were white, but many were brown or jet black. The black fungus is probably Cenococcum graniforme.^{2/} Mycorrhizae with black hyphae appeared to be more numerous in severely burned soil, although this was not demonstrated conclusively. Such an association might be expected, however, since C. graniforme has been observed to be particularly common in conditions where the activities of other mycorrhizal fungi are prevented.^{3/}

Mycorrhizae examined in this study of Douglas-fir roots were not dichotomous structures, such as those on ponderosa pine, but were unbranched.^{4/}

There was no relation between soil reaction and occurrence of mycorrhizae.

^{2/} Lihnell, Daniel. Cenococcum graniforme als mykorrhiza-bildner von Waldbäumen. Symbolae Bot. Upsalienses 2:1-19. 1942.

^{3/} Mikola, Peitsa. On the physiology and ecology of Cenococcum graniforme. Commun. Inst. Forest. Fenn. 36(3):1-104. 1948.

^{4/} Wright, Ernest. Importance of mycorrhizae to ponderosa pine seedlings. Forest Sci. 3:275-280. 1957.

SUMMARY

The occurrence of ectotrophic mycorrhizae on Douglas-fir seedling roots was investigated 1 and 2 years after logging and slash burning on the Wind River and H. J. Andrews Experimental Forests.

At Wind River, the number of mycorrhizal seedlings was related to severity of burning. At the H. J. Andrews forest, the number of mycorrhizal seedlings was related to whether or not the soil had been burned, but no real difference was found between intensities of burn. At both areas, a larger proportion of 2-year-old seedlings had mycorrhizal roots than in the 1-year-old seedling class.

Depth of first occurrence of mycorrhizae on the root system was related to severity of burn on 1-year-old seedlings. No differences were found in depth of occurrence in 2-year-old seedlings.

Abundance of mycorrhizae, as determined subjectively, was not associated with degree of burning.

Occurrence of mycorrhizae was not associated with soil reaction.