Burning Affects Water Intake Of Forest Soil

By Malcolm J. Zwolinski

FIGURE 1 — Application of a heavy burning treatment. Note how the fire is started at the plot perimeter and how it moves to the center to generate maximum heat.

The practice of controlled burning large acreages of forest lands in the west is becoming more accepted and is strongly advocated by several land management agencies.

It is felt that such a burning program, if properly administered, would reduce the potential of destructive wildfires by eliminating much of the fuel hazard. An additional benefit often claimed is the reduction in the number of trees in dense sapling-size forest thickets.

Decreases Water Intake

Some of the influences and implications of such a burning program are not completely understood. For example, studies have shown that burning causes a marked decrease in the rate of water intake by a soil. Here in Arizona, where the demand for water is increasing each year and where large controlled burning programs are being carried on, this question of water entry into the soil as influenced by burning assumes major significance.

The Department of Watershed Management is conducting a series of experiments in an attempt to determine whether the burning programs, as practiced on the Fort Apache Indian Reservation in east central Arizona, influence the rates of water entry into the soil.

Sites near McNary were chosen and treated with light and heavy burnings in the summer of 1963. This area was selected because of the extensive ponderosa pine type and because of the large scale burning program being carried out. Soils in the study area are classified in the Western Brown Forest great soil group. Dr. S. W. Buol has discussed these forested soils in a recent issue of *Progressive Agriculture* (Vol. 17, No. 3, p. 21).

Two Burning Treatments

Light and heavy burning treatments were controlled by the manner in which the fuel was ignited. For a light burn the flame was applied to the leeward side of the treatment area (usually 10 to 12 feet on a side) and the fire was allowed to burn slowly against the wind to the opposite side (Fig. 2).

This treatment removed the top layer of fresh needles and part of the underlying "F" or fermentation layer. Fusion pyrometers inserted into the soil indicated a soil surface temperature between 500° F. and 600° F., which, it is felt, corresponds quite closely to the burning intensity reached by the Bureau of Indian Affairs. Flame for the heavy burning treatment was applied nearly simultaneously to the perimeters of the treatment area and the fire moved to the center for maximum heat generation (Fig. 1). During this treatment, temperatures of 1200° F. were reached at the soil surface and complete litter removal ("L," litter; "F," fermentation; and "H," humus, layers) was accomplished. Each treatment, plus an undisturbed control plot, was replicated four times.

After treatment, infiltrometer plots were installed in the center of each treated and control areas with care being taken not to disturb the soil inside the plots. Prior to the initial infiltration runs the installed plots were covered with plastic to prevent surface disturbance by natural rainfall.

Water Application Measured

Water application rate by a North Fork type infiltrometer sprinkler assembly averaged about 7½ to 8 inches per hour (Fig. 3). The spray itself was a small to medium drop with no misting, and the application continued until runoff was constant for a minimum of 30 minutes. Consequently, the total time for most runs was over one hour. Infiltration rate was determined by taking the difference between the constant water application rate and the measured surface runoff in inches per hour for a number of time intervals. During the summer of 1963 two series of infiltration runs were conducted on all plots. The heavy burning treatments, where mineral soil was exposed, showed a substantial decrease in water intake (50 percent to 60 percent less than the untreated controls). A slight decrease of 10 percent to 15 percent was observed for the lightly burned plots. The plots were left exposed to the

(Continued on Next Page)

Mr. Zwolinski is an instructor-research associate in the Department of Watershed Management, Arizona Agricultural Experiment Station.

(Continued from Previous Page)

weather elements through the winter of 1963-1964.

In the spring and summer of 1964 additional infiltration runs were conducted on the same plots. Preliminary results from these data indicate that the infiltration rates for both the light and heavily burned plots have returned to nearly the same rate as the untreated controls.

It seems that the over-wintering effects of snow, freezing, and thawing, coupled with some herbaceous growth and needle fall on the burned surfaces, have exerted a beneficial influence on the rate of water intake. Additional data are being collected from these same plots in the summer of 1965, after exposure to another winter.

These results, which are not yet completely analyzed, indicate that controlled burning on the reservation, if carried out in the fall just prior to the accumulation of a protective snow cover, has little or no detrimental effect on water infiltration into the soil. Additional information pertaining to the changes in the physical properties of the soils due to the burning treatments is also being assembled.

FIGURE 2 — A light burn treatment made to simulate controlled burning. Note how the fire moves slowly across the plot without generating large amounts of heat.

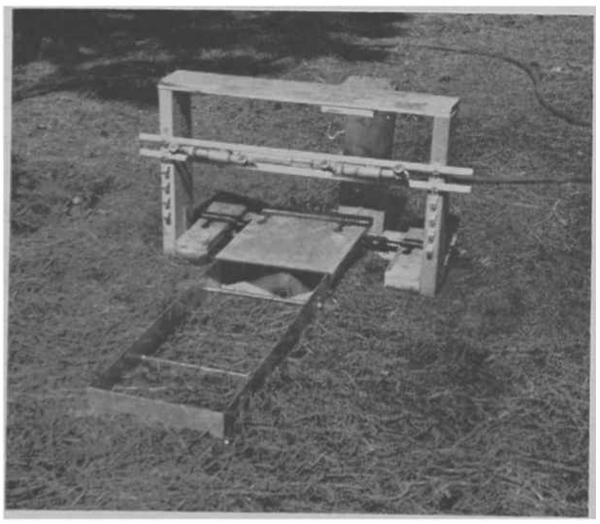

FIGURE 3 — North Fork infiltrometer sprinkler assembly in place over an untreated control plot. During the actual run, both the plot and the assembly are protected from wind effects by a plastic tent.