FIRE NC-4

Above and Below Ground Temperature Differences After Prescribed Burning In The Coastal Western Hemlock Zone of British Columbia

by

R.R. Lafferty

1973

Prescribed burning, initiated in the Southern Pacific Coast Region (C2) (Rowe, 1972) and conducted 21 May 1969 in a western hemlock (Tsuga heterophylla (Raf.) Sarge.) and western red cedar (Thuja plicata Donn.) type, increased soil temperatures at the soil surface and in the rooting zone of planted seedlings. In addition, postburn air temperatures at 15 cm (5.9 inches) were lower over the burned area than those in the slash, a further desirable factor in Douglas-fir seedling growth.

The study located 48 km (30 miles) east of Vancouver and at 153 m (500 ft.) (a.s.l.), consisted of data collected on a transect running horizontally along the middle third of a 30% north-facing slope over Orthic Concretionary Podzol Soils. The transect ran 160 m (525 feet) through 1) an 86-year-old second growth stand (canopy-closure 90%), 2) slash (about 224,172 kg/hec or 100 tons/acre), and 3) an adjacent burned area. The fire burned under high fire danger conditions, average mineral soil exposure was increased from 16 to 35% and, of the original 7.8 cm (3.0 inch) of duff, 3.4 cm (1.3 inch) was consumed (44%) on the average. There was never more than 2.5 cm (1 inch) of duff at a sample point on the burn.

In each type there were six soil temperature sampling stations and one hygrothermograph in a Stevenson screen 15 cm above ground. The soil temperatures were recorded from three permanently established thermistors; one at about 2 mm (3/16 inch), another 5 cm (1.9 inch) and the deepest 15 cm below the litter or mineral soil surface. In the unburned areas, the 5 cm probe was placed at the mineral soil-humus interface, or 2 cm (.8 inch) below the interface if the duff depth was less than 6.6 cm (3 inch), and the lowest probe 15 cm below the interface.

All readings and measurements were taken between 1300 and 1400 hr. PDT.

Soil temperatures in the burned area were always higher than in the slash; those in the slash were always higher than those in the stand. In the burned area, over a 60-day period, there were 204, 96 and 66 degree days 1/ more in the burned area than in the slash at the 2 mm, 5 cm and 15 cm depths, respectively.

In the burned area compared to the slash, temperatures averaged 25°C (77°F), 3.4 degrees higher, 19.4°C (67°F), 1.6 degrees higher and 17.8°C (64°F), 1.1 degrees higher at the 2 mm, 5 cm and 15 cm depths, respectively (Table 1).

Table 1. Average temperature differences at 4-levels on a burned area, in slash and in a stand.

	Burned	Slash	Stand
2 mm	25.0	21.6	15.5
5 cm	19.4	17.8	15.0
15 cm	17.8	16.7	14.4
15 cm air temp.	18.9	19.4	18.3

Figure 1 shows air and soil temperature differences on a relatively warm and cool day in June. On 17 June, a warm day, maximum ambient air temperature was 35°C (95°F) as measured at a nearby station. The 2 mm layer in the burned area at sampling time was 33.9°C (93°F), 5 degrees warmer than the 2 mm depth in the slash. Fifteen centimeters above ground, the air temperature in the burned area at sampling time was 29.4°C (85°F), 3.3 degrees less than in the slash.

On the cool day, 22 June, the temperature at the 2 mm depth in the slash was 15°C (59°F), less than 1 degree lower than in the burn type. Air temperature at 15 cm in the slash was 2.2 degrees higher.

Increased soil temperatures are beneficial if there is increased productivity from the site.

1/ Degree day = temp. diff. between burned and slash X number of sampling days.

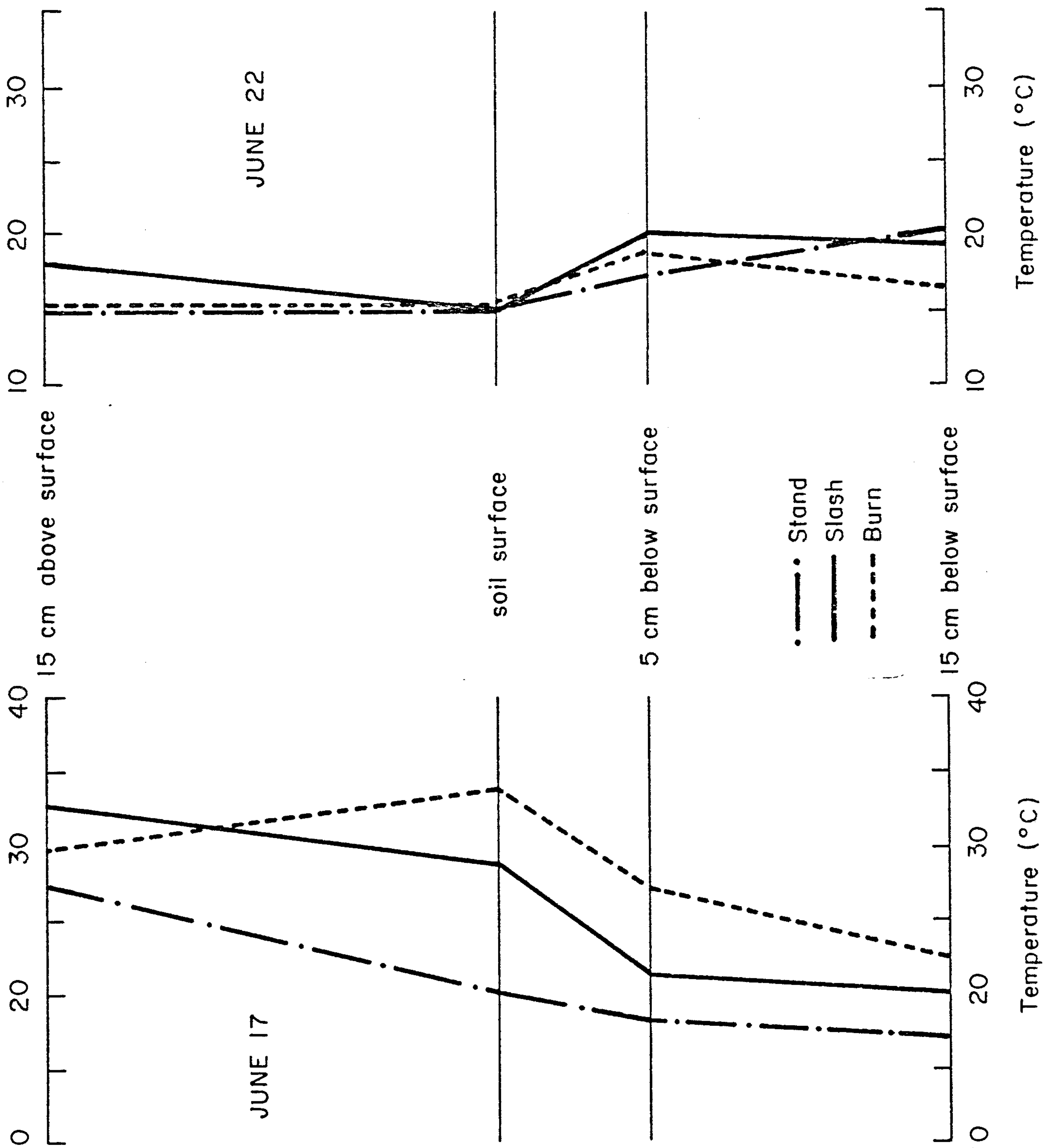

Fig 1. Air and soil temperature differences on a relatively warm and cool day in June.

Lavender and Overton (1973) showed increased maximum shoot growth in young Douglas-fir seedlings when the temperature of the soil in the rooting zone was 20°C (68°F). The soil temperatures in their tests were between 18°C (64°F) and 24°C (75°F), similar to soil temperatures in our study.

Cox and Boerma (1967) and Anderson and McNaughton (1973) have shown significant increases in plant growth with increased soil temperatures between 2.8 and 27.2°C (37 and 81°F). However, there may have been many reasons for the increased growth; i.e., plants have different growth responses to soil temperatures, depending on species, provenance, soil moisture, air temperature and soil fertility.

Babalola et al. (1968) and Cameron (1941) found that increased soil temperature, from 3 to 28°C in the rooting zone, had the effect of increasing transpiration rate, and that higher soil temperature also increased respiration and photosynthesis rates (Bowen, 1970), in coniferous seedling (*Pinus radiata*) and other species. Lower temperatures also increased water tension, and the greater the water tension, the lower the transpiration, respiration and photosynthesis rates (Cox and Boersma, 1967). Using native plant species, Anderson and McNaughton (1973) showed that low soil temperature had no adverse effect on transpiration and photosynthesis but did significantly retard plant growth. They concluded that growth reduction at low soil temperatures resulted from reduced turgor, decreased root growth and metabolism, or reduced cytokinin synthesis and translocation.

Assuming that increased soil temperatures were significantly beneficial to seedling growth under the environmental conditions of vegetation, climate, site, etc., experienced in our study, a site treatment that allows soil temperatures to increase in the rooting zone is desirable. In fact, results of a preliminary review of data in a seedling growth study in the same area showed that 2-1 Douglas-fir seedlings, planted five years previously, grew 3 feet more than those on the adjacent non-burned area.

Soil temperatures in the rooting zone of young Douglas-fir seedlings, the first summer after prescribed burning, were always higher at sampling time in the prescribed burned area than in a slash-covered area or in a stand. Air temperatures in the leaf area of conifer seedlings, 15 cm above ground, were always lower over the burned area than in the slash, probably because of increased reflection and decreased air movement in the latter. This effect will probably diminish after ingrowth vegetation shades the ground.