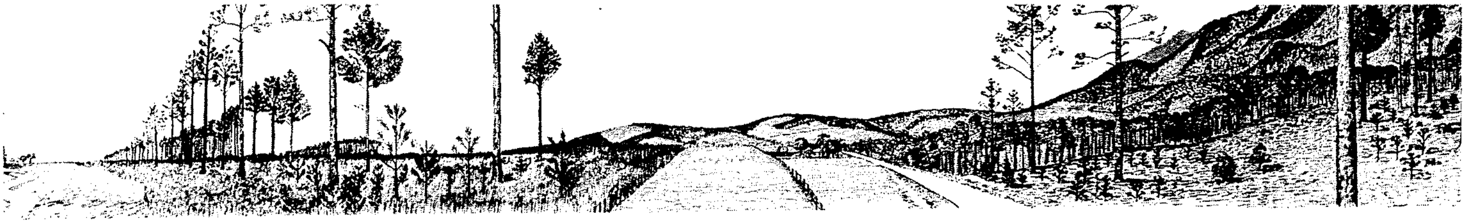

USDA Forest Service Research Note SE-157 March 1971

REPLICATION OF PINE NEEDLE FUEL BEDS

Abstract.--A technique for building pine needle fuel beds has been developed and tested which assures uniform rates of spread and independence of the builder. Five beds were constructed by each of two technicians. They were burned under identical conditions and a comparison made of the time the fires took to spread 24 inches. A t-test showed that there was no difference between the beds of the two builders (t = 0.265, 8 d.f.). For the 10 beds, the mean was 2.06 minutes, the standard deviation was 0.09 minute, and the coefficient of variation was 4.1 percent.

One of the major problems that faces fire researchers who work in a laboratory environment has been the development of a fuel bed which has characteristics similar to natural fuels and can, at the same time, be replicated. Hand-loaded beds of pine needles are commonly used for many experiments but they have not been entirely satisfactory because the resulting fires have shown a large variance. Thus, it is necessary to repeat the experiments many times in order to give statistical support to the results.

This Note describes a method for constructing fuel beds[1] which produce consistent test fires. Schuette suggested a procedure for constructing needle fuel beds,[2] and although we have incorporated many of the steps he suggested, our method differs significantly from his for the actual assembly of the fuel bed.

This method produces a needle fuel complex which is useful for experimental purposes. The technique assures the following desirable bed characteristics:

1. Uniform loading
2. Uniform fuel density (compaction)
3. Random arrangement of fuel particles.

[1] Originally proposed by A. T. Altobellis, a former member of the research staff at the Southern Forest Fire Laboratory.

[2] Schuette, Robert D. Preparing reproducible pine needle fuel beds. Intermountain Forest & Range Exp. Sta., U. S. Forest Serv. Res. Note INT-36, 7 pp. 1965.

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Procedure

The fuel for the beds is taken from a supply of clean, fresh-fallen needles of a single species and placed in a drying oven at 125° F. After it is determined that the sample is no longer losing weight, the bulk fuel is placed in a conditioning cabinet at the temperature and humidity necessary to bring the fuel to the desired equilibrium moisture content. Drying is necessary to insure that the desired equilibrium moisture content is always attained by adsorption. A different equilibrium moisture content will result if it is attained by desorption.

The fuel bed construction technique requires a device which will allow individual needles to free fall onto the wire tray designed to hold the fuel while it is burned. The particular device used here is a cabinet-like affair with the uppermost section holding a grate constructed of $\frac{1}{4}$-inch steel rods arranged parallel in two layers; the lower section holds the tray to be filled with needles. The rods are spaced 1 inch center-to-center within layers and $\frac{1}{2}$ inch center-to-center between layers. The rods are staggered so that no two are in line vertically. The wire tray is placed in the bottom of the box, 34 inches below the grate (fig. 1).

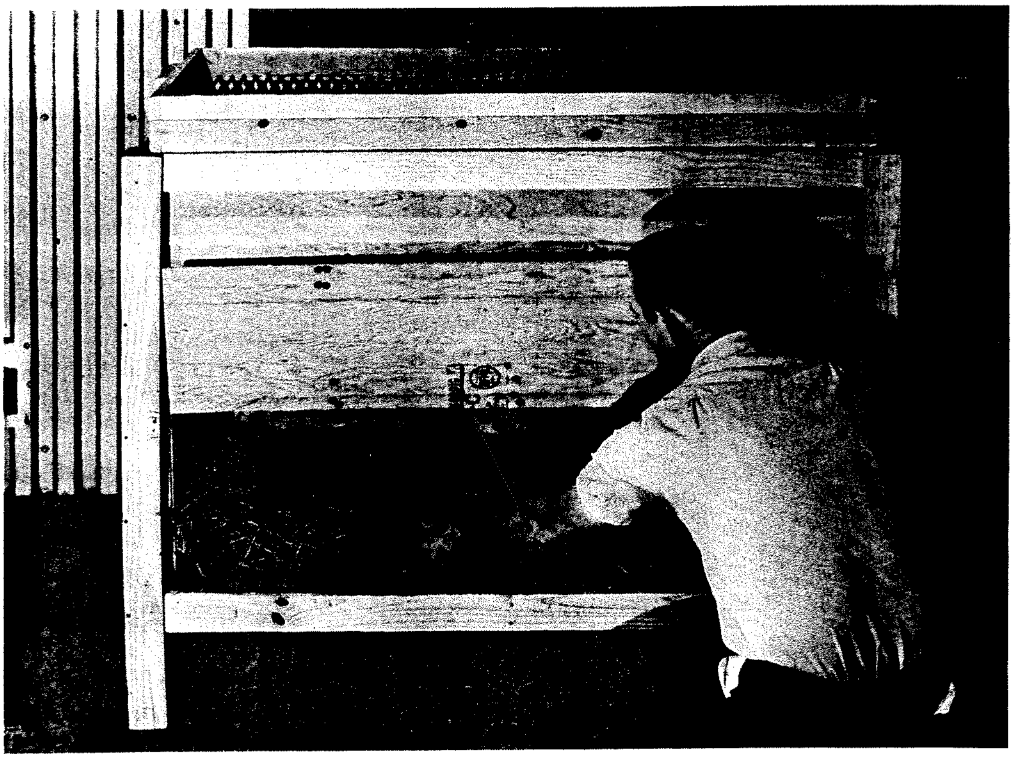

Figure 1.--Technician removes a completed fuel bed from the bottom of the fuel bed fabricator. Note the arrangement of the rods which make up the grate.

Working the needles through the grating by rubbing the needles over the grating area produces a natural arrangement of the fuel particles by breaking up clumps so that the needles fall onto the bed individually, similar to a natural needle fall. The lateral distribution of needles is accomplished by dividing the desired amount of fuel into several equal parts, and evenly spreading one part at a time over the grate before agitation (fig. 2). Time required to construct a fuel bed in this way is approximately 30 minutes.

The spacing of the rods, as described, works well with slash and loblolly needles (7 to 9 inches long); if other species are used, however, some changes in these specifications may be necessary.

Five 18- by 48-inch beds, each containing 3 pounds of loblolly pine needles at 11 percent moisture content, were constructed by each of two technicians to test reproducibility and dependency of the beds on the individual builder. The beds were burned on zero slope at 60 percent relative humidity in the Laboratory's combustion room.

Figure 2.--One pound of loblolly pine needles is placed on the top of the fabricator. After the needles are uniformly distributed over the grate, they will be moved into position between the bars and allowed to free fall into the tray below.

Results

Summarized below are the times the 10 fires took to spread from the 18-inch mark to the 42-inch mark. The first 18 inches was not counted because the fires took that distance to obtain a steady state; the last 6 inches was omitted to eliminate the effect of air entrainment through the open end of the bed.

Technician 1

Fire	Time (Min.)
1	2.16
2	2.12
3	1.93
4	2.07
5	2.07

$Mean_1$ = 2.07 min.

s_1 = 0.09 min.

C_1 = 4.3 percent

Technician 2

Fire	Time (Min.)
6	1.93
7	2.09
8	2.03
9	2.14
10	2.09

$Mean_2$ = 2.06 min.

s_2 = 0.08 min.

C_2 = 3.9 percent

A comparison of the two groups of fires by means of a t-test showed that there was no difference between the beds made by the two technicians ($t = 0.265$, 8 d.f.). For the 10 beds, the mean was 2.06 minutes, the standard deviation (s) was 0.09 minute, and the coefficient of variation (C) was 4.1 percent.

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