EFFECT OF BLACK POLYETHYLENE MULCH ON SURVIVAL OF DOUGLAS-FIR SEEDLINGS, SOIL MOISTURE CONTENT, AND SOIL TEMPERATURE

Mulching raises survival but doubles planting time. It will be cheaper to plant more seedlings.

W. Lopushinsky and T. Beebe
Pacific Northwest Forest and Range Experiment Station, Wenatchee, WA., and Wenatchee Nat'l Forest, Entiat, WA.

Lack of adequate soil moisture during the growing season often limits survival of planted conifer seedlings in eastern Washington. A mulch around seedlings ought to conserve moisture in the root zone; increased survival as a result of mulching has been reported (1, 2). However, some results have been inconclusive (3), indicating that the benefits of a specific mulch in a particular area cannot always be predicted. This report describes the effects of mulching with black polyethylene on seedling survival, soil moisture content, and soil temperature.

Methods

The study site was at 2,700-feet (823-m) elevation on a fairly level bench area adjacent to Brennegan Creek, a tributary to the Entiat River in north-central Washington. Exposure is to the west. At 3,000 feet (914 m), average annual precipitation is 22 inches (559 mm) per year, and the mean annual temperature is 44.3° F (6.8° C). Summers are hot and dry, with only 13 percent of the precipitation occurring from June to September.

Soils are coarse and deep, developing in coarse ash or pumice over granitic bedrock. The area was burned severely by a forest fire in 1970. Vegetation following the fire consisted mostly of artificially seeded orchard-grass (Dactylis glomerata L.) and scattered snowbrush ceanothus (Ceanothus velutinus Dougl.). Standing snags provided partial shade in some areas.

On May 4, 1973, 2,100 2-0 Douglas-fir seedlings, grown at Coeur d'Alene Nursery from locally collected seed, were planted. Planting spots were scalped of surface vegetation for a 2- x 2-foot (0.6- x 0.6-m) area, and the seedlings were planted on a 6- x 6-foot (1.8- x 1.8-m) spacing using a Reindt pattern mattock. Soil-moisture tension measured just before planting was about 0.2 bar.

Half of the seedlings were mulched immediately after planting with a 2- x 2-foot (0.6- x 0.6-m) piece of 4-mil black polyethylene with a 4-inch (10.2-cm) slit in the center for the seedling (figure 1). The other half, which were not mulched, alternated within each row with the mulched seedlings. The mulch was held in place with soil clods, pieces of branches, and other natural debris. No attempts were made to seal all edges of the mulch because an objective of the test was to determine the effectiveness of the mulch applied in a normal planting operation.

Soil moisture and temperature were measured on four plots located in the planted area. Each plot consisted of six mulched spots and six nearby unmulched spots. Seedlings at these 12 spots in each plot were cut off at the ground line to eliminate the problem of variable water uptake by seedlings of different size. At two of the mulched and unmulched spots, gypsum blocks to monitor soil moisture were installed at 6, 12, and 18 inches (15.2, 30.5, and 45.7 cm), along with thermistors at the same depths and also just under the surface, to measure soil temperature. Measurements were taken nine times from May to September. Samples of soil were taken at the remaining four mulched and unmulched spots three times during the spring and summer for gravimetric determination of soil water content. Samples were taken at 6 and 12 inches (15.2 and 30.5 cm) and dried at 221^0 F (105° C), and moisture content was calculated as a percent of ovendry weight.

Results and Discussion

A count made in June, 7 weeks after planting, showed that survival of the mulched seedlings was 94 percent compared with 91 percent for unmulched seedlings. In October, 18 weeks after planting, survival of mulched seedlings was 47 percent and that of unmulched, 33 percent. A t-test showed that this difference was significant at the 5-percent probability level. Thus, the use of plastic mulch did not increase survival as much as might have

been expected. Part of the explanation may be that after initial drying of the surface soil, the pumice dust layer itself acts as a mulch to slow down further water loss from deeper layers in the soil. No consistent differences in soil moisture content were found between mulched and unmulched spots; However, moisture contents were highly variable from spot to spot within both mulched and unmulched groups so that valid comparisons were not possible.

During the period May to September, the temperature of the soil at the surface ranged from *1.3°* to 10.1° F (0.7° to *5.6° C)* higher at unmulched spots than at mulched spots. The greater surface temperatures at the bare spots may have resulted from higher temporary heating because of low thermal conductivity of the exposed soil surface at midday on clear, sunny days when the measurements were taken. At *6, 12,* and 18 inches *(15.2, 30.5,* and *45.7* cm), however, soil temperatures were always higher under the mulch than under unmulched spots, with the effect decreasing with depth. Average soil temperature from May to September under the mulch at *6* inches *(15.2* cm) was *2.7°* F *(1.5°* C); at *12* inches *(30.5* cm), *2.2°* F *(1.2°* C); and at 18 inches *(45.7* cm), *0.7° F (0.4° C)* higher than the same depth at unmulched spots.

These temperature increases probably are too small to significantly influence seedling survival, considering the major effect of decreasing moisture availability.

It is apparent that the effectiveness of this type of mulch depends greatly on how well it is applied. Mulch placed on sloping areas tends to slide. Also, because of the unevenness of the ground surface, edges and corners of the mulch anchored lightly with debris tended to move because of wind, decreasing the effective area and thus the efficiency of the mulch. Consequently, if black plastic mulch is used to conserve soil moisture, it must be applied carefully, preferably covered with a layer of soil to hold it in place and to seal the edges.

The rather small beneficial effect of the mulch on survival in the present test raises some questions concerning its value in reforestation under certain conditions. Application of the mulch approximately doubled the planting time required per acre. From an economic standpoint, reforestation may be accomplished more cheaply by simply planting more seedlings per unit area.

Figure 1. *Typical mulch application of black polyethylene around Douglas-fir seedling.*

Literature Cited

1. Hermann, R. K.
1964. Paper mulch for reforestation in southwestern Oregon. J. For. 62:98-101
2. Hunt, L. O.
1963. Evaluation of various mulching materials used to improve plantation survival. Tree Planters'. Notes 57:19-22
3. Rietveld, W. J., and L. J. Heidmann.
1974. Mulching planted ponderosa pine seedlings in Arizona gives mixed results. USDA For. Serv. Res. Note RM-257, 3 p.