ADVERSE EFFECTS FROM MULCHING SPRUCE SEEDLINGS

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Mulching, especially light colored or reflective materials, can be expected to increase maximum air temperatures above the mulch surface and might, therefore, be detrimental to tree seedlings (Geiger 1965, Maguire 1955). Yet several successful tests of various mulching materials to improve seedling survival have been reported from regions with relatively severe summer climate (Hunt 1963, Hermann 1964). For this reason, the adverse heat effects of mulch treatments on spruce seedlings observed in two studies in the moderate summer climate of the Allegheny Uplands of New York emphasize this potential hazard under some conditions.

A study of the effects of herbaceous vegetation control on white spruce *(Picea glauca* (Moench) Voss) seedlings included white fiberglass batts, 22 inches square by 2 inches thick, as one of the treatments. These batts placed around newly planted 3-0 seedlings in April 1964 resulted in nearly as effective soil moisture conservation during the first summer as did complete vegetation removal by herbicides. Maximum temperatures of the soil surface under the mulch averaged up to 5° F. lower than under adjacent untreated vegetation. However, during July many mulched seedlings began to brown and by September, 25 percent had died. Another 25 percent were damaged so severely that they succumbed the following year. In contrast, no first year mortality occurred among untreated seedlings.

The pattern of dying, progressing from the lower stem and branches upward, while roots remained apparently healthy, indicated the cause as heat injury above the fiberglass surface. The lethal effects were thought to have occurred on a single afternoon, July 1, when the nearby weather station maximum temperature of 89° F. was the highest recorded for the year. On the basis of thermocouple temperature measurements taken on cooler days, air temperature over the mulch that afternoon is believed to have been in excess of 115^0 F. for an hour or longer. Although this is slightly below temperatures reported by Hare (1961) to be lethal to seedling tissue, it might well be injurious to spruce seedlings, known to be quite sensitive to heat injury (Korstain and Fetherolf 1921), probably because of their relatively thin dark bark and a top form that typically provides little self-shading of the lower stem. Uninjured seedlings in the mulch plots invariably had either partial shading from adjacent tall weeds or a degree of self-shading from their own tops.

The following year, a mulch of spruce needle litter about 1 foot square by $i/_2$ inch thick was included among treatments in a study of 3-0 Norway spruce *(Picea abies (L.)* Karst.) seedlings. This mulch did not significantly' control herbaceous vegetation or conserve soil moisture, but during the first summer several mulched seedlings developed browning progressing from the base upward similar to but less serious than that observed on the fiberglass mulched white spruce. A few of the damaged seedlings died the following season, whereas there was no mortality among the untreated seedlings.

On a warm July day the following summer, maximum shielded thermocouple temperatures of 125^0 F. were registered within 1 cm. of the spruce litter surface, whereas 108° was recorded both over

fiberglass and over a chemically killed grass mat, 105° over bare dry soil, and 88° at the base of dense herbaceous cover, when the recorded maximum at the nearby weather station was 81° F. This suggests that the mat of flat, glossy spruce needles caused even higher heat buildups than the fiberglass and was probably less lethal to spruce seedlings only because it covered a smaller area and permitted more shading from adjacent vegetation.

These experiences illustrate that, for relatively heat sensitive tree species at least, excessive temperatures above light colored or reflective mulch surfaces can sometimes offset any benefits from improved environmental conditions under the mulch. This hazard is reduced by shading from nearby vegetation or by self-shading of the lower stem and needles by the seedlings themselves.

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