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DROUGHT EFFECTS ON CONIFERS IN THE PACIFIC NORTHWEST, 1958-59

by

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The summer of 1958 was unusually hot in most of Oregon and Washington, and that of 1959 was unusually dry except in western Washington. Killing of young conifers, similar to that in northern Idaho,[1/] was common in a few localities in northwestern Washington by the end of the 1958 growing season, but did not continue in 1959 and was not seen elsewhere. Various other effects of drought were visible during both years throughout the region.

BRANCH KILLING

During 1958, moderate to large increases in numbers of flags occurred in many forest types, including some of the upper-slope types. In some instances, flagging was concentrated in a small part of the crown, and in others ranged from scattered to general over most of the crown. It was most frequent at lower elevations, especially in ponderosa pine types (fig. 1) within a few miles of the so-called desert fringe where the forest gives way to juniper woodland and sagebrush. It became increasingly abundant as the growing season progressed, and continued to be more than ordinarily common in 1959.

[1/] Leaphart, Charles D. Drought damage to western white pine and associated tree species. Plant Dis. Rptr. 43: 809-813, illus. 1959.

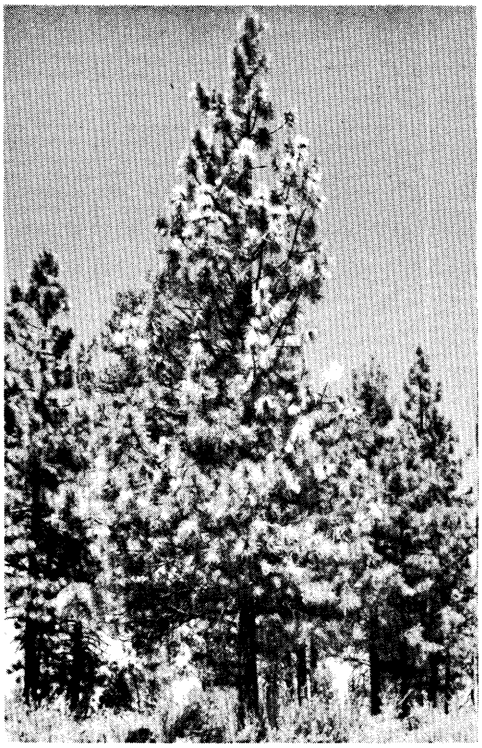

Figure 1.--Flags on young ponderosa pine. Red foliage appears white in the photograph.

With occasional exceptions, these twigs and branches had previously been injured by such things as fungi, dwarfmistletoes, insects, and hail. In two ponderosa pine stands, for example, widespread flagging in large trees over areas of several hundred acres was associated with great numbers of western gall rust (Peridermium harknessii) infections high in the crowns, where sporadic flagging during the past several years had gone unnoticed. Some of the injuries were trivial, but most of them would have killed the affected branches within a few years, even under ordinary weather conditions.

Flagging of this kind appeared in many instances before soil moisture became seriously depleted, and it was often abundant on sites where no other reaction to unfavorable weather was evident. Therefore, it appears attributable at least in part to the record-breaking heat and accompanying dry winds of 1958 rather than to rainfall deficiency. Twigs with defective translocation systems were apparently unable to endure moisture stresses in the foliage during critical periods, even though roots were functioning and soil moisture was still adequate.

Another kind of branch killing appeared later, after soil moisture had become noticeably deficient. On many saplings and poles--especially ponderosa pine--the lowermost 2 or 3 feet of the crowns suddenly died, even where they were exposed to full sunlight and where normal complements of long needles indicated that the killed branches had been in good vigor at the start of the growing season (fig. 2). This kind of killing was much more common in 1959 than in 1958, and was invariably associated with other effects of drought.

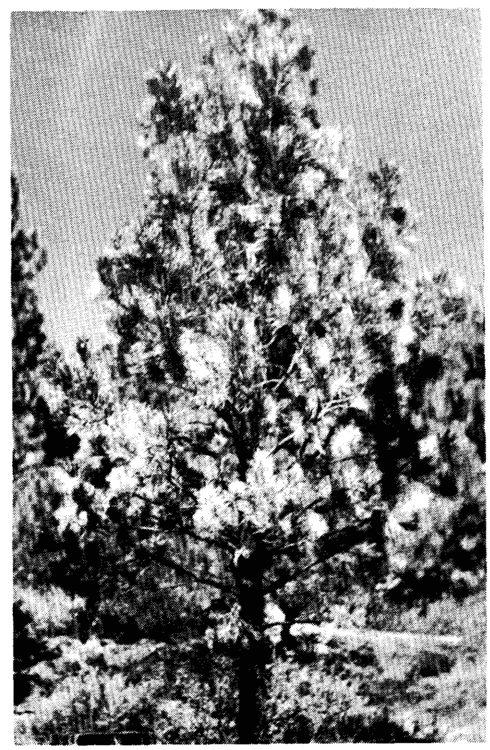

Figure 2.--Dying of lower branches on ponderosa pine sapling. Brown foliage appears almost white in the photograph.

PREMATURE DEATH OF OLDER FOLIAGE

In 1959, and to a lesser extent in 1958, dying of foliage started earlier and involved more of the old needles than usual. This reaction is fairly common, even during periods of only moderate drought, and is sometimes so extensive that orange needles in the interiors of Douglas-fir crowns give a lemon-yellow tinge to distant stands. In extreme instances, all but the current season's needles may die on ponderosa pines, and all but about the last four seasons' on Douglas-firs.

Such dying of older foliage, and of lower branches as well, appears to be a survival mechanism by which the tree becomes adapted to intermittent droughts. Through elimination of parts of the crown that are least efficient photosynthetically, the necessary reduction of transpiration is effected with minimum sacrifice of carbohydrate production.

TOP KILLING

During both years, top killing was confined almost entirely to Douglas-fir saplings and poles on droughty soils, usually at or near the edges of natural openings in the forest. It was conspicuous on clay soils along the east side of the Mount Hood National Forest, where similar injury also occurred during the drought of the late 1920's and early 1930's. Other forms of drought injury were common on associated conifers.

In most instances, fruiting bodies of weakly parasitic fungi were present near the bottoms of the killed sections. Observations under other conditions suggest that these fungi may have been the immediate cause of the killing. Nevertheless, close correlation between top killing and obviously unfavorable environments indicates that weakening of trees by drought, to an extent permitting invasion by weak pathogens, was the primary cause.

ECONOMIC DAMAGE

The effects of drought are ordinarily most conspicuous in small trees on the poorest sites, where they are of least economic consequence. Tops killed by drought, for example, present an alarming appearance but occur principally on sites incapable of producing commercial timber. On somewhat better sites, extensive dying of older foliage and lower branches may be so striking as to give the impression of a dying stand, but even in such instances it is usually only a symptom of temporary retrenchment. On fair to good sites, mortality in young stands is rarely extensive enough to impair stocking.

Where larger trees have died as a result of almost simultaneous death of hundreds of injured branches--as, for example, in stands severely infected by western gall rust--it is obvious that adverse weather hastened damage, but the proportion of the damage attributable to weather cannot be estimated satisfactorily. The most vigorous of such trees could have been expected to survive indefinitely if gradual flagging had permitted compensation by new growth. The least vigorous would, in any event, have died within a few years from attrition of their crowns. What would have happened to most of the trees under favorable weather conditions is problematical.

In this connection, it should be noted that drought effects probably include some minor, long-range benefits. Killing of branches infected by obligate parasites, such as dwarfmistletoes, may slightly hinder the spread of disease by diminishing the supply of inoculum. Killing of heavily parasitized trees stops their pollen and seed production, thereby presumably decreasing in the next rotation the proportion of trees highly susceptible to the given disease. Killing of lower branches and occasional trees in young stands reduces to a slight extent the need for pruning and thinning. Even in the aggregate, however, these benefits appear negligible.

Of the economic loss directly attributable to drought, by far the greater part has undoubtedly resulted from inconspicuous but general decrease in current increment throughout most of the region. Whether or not the drought continues, additional damage must be expected during the next few years as weakened trees fall prey to root rots, insects, and other enemies.