Coniferous Seedling Survival

poor survival may be due to physiological conditions associated with root-producing ability of planting stock

Edward C. Stone

Fall lifted Jeffrey pine seedlings 60 days after planting in the greenhouse. *Right*, seedling representative of the 80% that produced roots; *left*, seedling representative of the 20% that had not produced roots.

At least half of the more than 12 million coniferous seedlings planted in California during the past five years failed to survive their first summer in the field. Part of this failure can be related to factors such as rodents, livestock, and competing vegetation. On the other hand, there are many instances where the reason is not apparent; not even the long summer drought nor the high temperatures associated with California's Mediterranean-like climate are satisfactory explanations.

The present study was undertaken to determine whether or not some physiological condition of the seedling itself is responsible for low survivals. The question of how such physiological conditions might be altered if they occur and to what extent they might be genetically controlled was not considered. However, in the light of the results obtained, further experiments are being set up to study the problem in its entirety.

Failure of either the root system, or the top—or both— to develop properly would be evidence of a potentially detrimental physiological condition. If the root system did nut increase in size,

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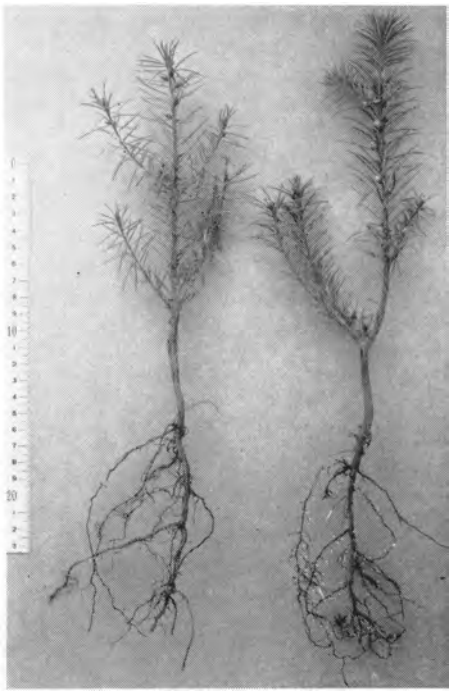

Fall lifted red fir seedlings 60 days after planting in the greenhouse. *Right*, seedling representative of the 76% that produced roots; *left*, seedling representative of the 24% that had not produced roots.

Fall lifted white fir seedlings 60 days after planting in the greenhouse. *Right*, seedling representative of the 72% that produced roots; *left*, seedling representative of the 28% that had not produced roots.

Fall lifted ponderosa pine seedlings 60 days after planting in the greenhouse. *Right*, seedling representative of the 84% that produced roots; *left*, seedling representative of the 16% that had not produced roots.

Fall lifted Douglasfir seedlings 60 days after planting in the greenhouse. *Right*, seedling representative of the 60% that produced roots; *left*, seedling representative of the 40% that had not produced roots.

RED MITE

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good control of the mite eggs. Ovotran, however, at a dosage high enough to give egg control, caused damage in combination with lime sulfur. Sulphenone, the other material tested, was ineffective against the winter eggs.

In the winter of 1954, a more extensive plot was established in a mixed Hardy and Bartlett pear orchard that had a history of severe European red mite attack. Mite eggs were very numerous on the buds, twigs, and branches. Single tree plots were used, replicated eight times, and randomized. Sixteen check trees were included and randomized throughout the plot area. Dormant, delayed dormant, and cluster-bud treatments were used, and applications were made with conventional ground equipment.

The plots were evaluated during the foliage season by making mite counts at two-week intervals. The results of the 1954 plots are shown in the two accompanying charts. Plots were retreated when the mite populations reached an average of 4–5 European red mites per leaf, as previous work has shown that an average of 4–5 European red mites per leaf is capable of causing leaf bronzing and leaf burn.

Dormant oils held the mites in check until June, and the oil-parathion combination was slightly better. It is doubtful if the slightly more effective oil-parathion combination would replace the standard dormant oil suggestion in view of the hazardous nature of the combination. Oil and malathion was not effective against the overwintering mite eggs and required retreatment at the same time as the checks.

Of the delayed dormant and cluster bud sprays, Genite-923 and Mitox were the only materials to give adequate control, and these plots did not require treatment until July. The other acaricides, although reducing mite populations below that of the checks, did not give commercial control.

Genite-923 has been tested for two seasons and has given good results each time as a prebloom spray. Mitox is as yet an experimental product and will be retested the coming season.

From these experiments, it is evident that a prebloom treatment with the proper acaricide will hold the European red mite in check until the summer period, when other acaricides can be used without fear of injury to foliage or fruit.

Harold F. Madsen is Assistant Entomologist, University of California, Berkeley.

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CONIFEROUS

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either by elongation or regeneration, at a fairly rapid rate, the seedling would die of drought when the moisture content of the soil surrounding the roots approached the wilting point. Lack of top development, on the other hand, would probably not become critical in itself during the first year after planting. For this reason, the absence of root development was the criterion used in this study to indicate an unsatisfactory physiological condition of the seedling.

Greenhouse Test

In brief, the experiment consisted of: *a*, planting fall lifted nursery stock in one-gallon cans; *b*, moving the cans into a greenhouse where favorable growth conditions were maintained; *c*, washing out the seedlings after 60 days to observe their root development; and *d*, replanting the seedlings again in the same cans to observe their survival 120 days later.

The planting stock was obtained from the U.S. Forest Service nursery at Oakdale, the California Forest and Range Experiment Station Nursery at Pinecrest, and the California State Division of Forestry Nursery at Fort Bragg; the ponderosa pine and red fir came from Oakdale, the Jeffrey pine and white fir from Pinecrest, and the Douglasfir from Fort Bragg.

The stock from Oakdale and Pinecrest was lifted in the rain during the second week of November 1953, carefully packed in sphagnum moss and transported to Berkeley all in the same day. It was planted in cans two weeks later.

The stock from Fort Bragg was lifted in the middle of October and then stored at 38F in a cold storage plant in Eureka until it was shipped to Berkeley in February 1954. This stock was planted in cans during the first week of March. All stock when received in Berkeley was placed in cold storage at 41F until used.

Each of the species was represented by five samples of 10 seedlings—a total of 50. These were all root pruned to approximately 5″ so that they would fit into the gallon cans when planted.

The soil used to fill the cans was sandy loam from a mixed conifer stand growing on a good site near Pinecrest.

Sixty days after the seedlings had been planted they all appeared healthy. However, when the seedlings were washed out of the cans, a pronounced difference in new root development was evident. As shown in the accompanying table, all the species tested showed some root production failures.

Root Production Failure on Five Different Species of Transplant Stock

Species & Nursery	Time of lifting	Time of planting	Kind of stock	Per cent without roots after 60 days		Per cent without roots after 180 days	
				Mean	S.E.M.*	Mean	S.E.M.*
Pinus Jeffreyi (Pinecrest)	fall	fall	2–0	20	±4.5	18	±4.0
Abies concolor (Pinecrest)	fall	fall	2–0	28	±4.0	20	±3.0
Pinus ponderosa (Oakdale)	fall	fall	1–1	16	±4.0	12	±2.5
Abies magnifica (Oakdale)	fall	fall	1–1	24	±4.0	24	±4.0
Pseudotsuga taxifolia (Fort Bragg)	fall	spring	1–1	40	±4.5	40	±4.5

*Standard error of the mean

Findings

Close examination of the seedlings that produced roots and of those that failed to do so did not reveal any external morphological differences. Apparently some physiological condition exists which is associated with the ability of seedlings to produce new roots but not with any external morphological difference.

Some objection might be raised to the 5″ pruning procedure that was used. However, since the roots of all stock were pruned to the same length and since new root development was not restricted to the lower portion of the original root system, the severe pruning practiced was considered unimportant in these initial experiments.

One hundred and twenty days after replanting—180 days from the beginning of the experiment—almost all the seedlings which had not produced roots in the first 60 days were dead. The tops were dry and brown and the needles had started to fall. A few were still alive and when re-dug showed new root development. Apparently, the physiological condition that prevented root production during the first 60 days after planting was not sufficiently altered in the next 120 days to allow new root development to take place.

Edward C. Stone is Assistant Professor of Forestry, University of California, Berkeley.

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