

Root Regeneration by Seedlings

ability of ponderosa pine seedling to regenerate root system rapidly after transplanting is important factor in survival

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Erratic results obtained in organized ponderosa pine planting programs—some successful, more not successful—emphasized the need for reliable planting systems applicable to California conditions.

Investigations designed to search for suitable combinations of site preparation, lifting time, storage conditions, and planting techniques were started with a study of the ability of ponderosa seedlings to regenerate an extensive root system.

Root Damage

When a seedling is dug for bare-root transplanting, the primary root, most of the elongated laterals, and a number of the short laterals are broken off. Unless some of the unbroken short laterals elongate rapidly after replanting—or new laterals are initiated and elongate rapidly—the available moisture in the soil in immediate contact with the reduced root system is soon exhausted. Unlike an actively elongating root system which continually taps new sources of soil moisture, a reduced root system becomes dependent upon moisture diffusing into the root zone from increasingly greater distances through the soil mass. Eventually, when the transpiration rate exceeds the soil moisture diffusion rate, the seedling dries out and dies.

A study considered to be a necessary preliminary to the development of reli-

A portion of the root system showing both root elongation and root initiation. Magnified 14 times. The branched portions to the left are actively elongating; the light spots on the unbranched portion to the right are recently initiated laterals.



able planting systems was—in essence—a simple study. Seedlings were dug from the nursery each month, replanted in the greenhouse, redug 30 days later and the number of new roots counted and measured.

Two year old ponderosa pine seedlings from seed collected in the southern westside Sierra or Zone V were used in the 1955-56 series and from the northern westside Sierra or Zone III in the 1956-

57 series. Both lots of seed were planted at the United States Forest Service Mt. Shasta nursery near McCloud. When the Zone III seedlings were a year old they were transplanted and grown the second year at the Institute of Forest Genetics nursery near Placerville. Thus the seedlings used in the two series were of a different seed source and—because Placerville has a milder climate and a longer growing season than McCloud—the seedlings were grown in different climates.

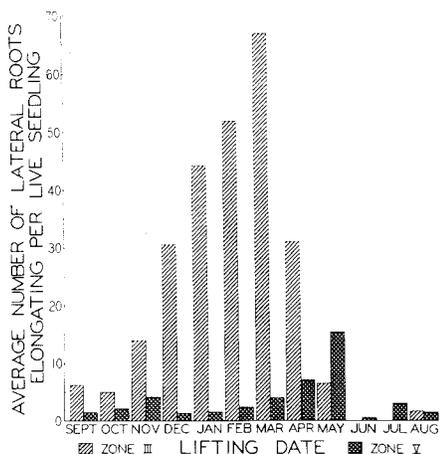
Greenhouse Tests

Seedlings were dug on or about the first day of each month, packed in peat moss, shingle-tow, or vermiculite, and shipped to Berkeley where they were immediately placed in cold storage at 34°F until used, occasionally as long as four or five days later. Immediately previous to planting, the roots were pruned to approximately 6" and any white root tips still present were pinched off.

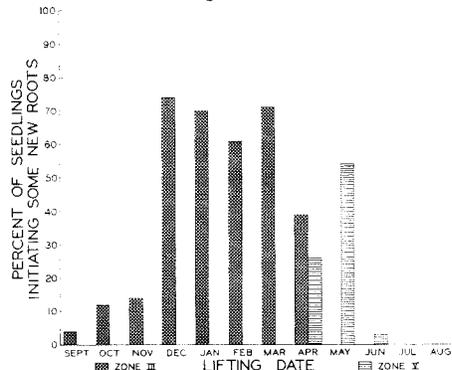
For the 1955-56 series, 10 seedlings were planted in each of eight crocks filled with sand. Two crocks were then placed in each of four constant temperature water baths maintained at 50°F, 59°F, 68°F, and 77°F. Each crock was watered initially and three times each week thereafter with one-tenth strength Hoagland's solution. The excess solution which drained to the bottom after each application was removed through an inverted glass thistle tube connected to a trap and a vacuum line. Thirty days after the seedlings had been planted the crocks

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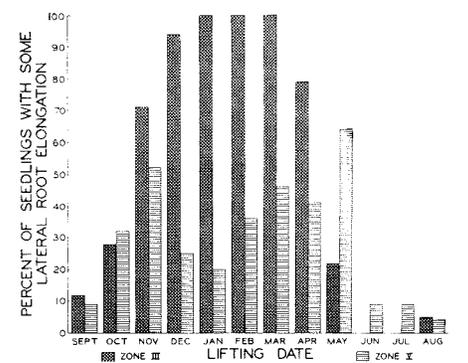
Average number of lateral roots per live seedling showing elongation within one month after transplanting to the greenhouse.



Percent of seedlings showing lateral root initiation within one month after being transplanted to the greenhouse.



Percent of seedlings that showed some lateral root elongation within one month after being transplanted to the greenhouse.



MEALYBUG

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bined with dormant oil. The same spray equipment was used, and an average of 600 gallons was applied per acre.

With the fall and winter sprays, an attempt was made to determine the percentage kill of crawlers by removing the overwintering cottony egg sacs from the limbs and trunks of the trees. They were brought to the laboratory and examined under a binocular microscope in order to determine the number of living and dead crawlers. The plots were finally evaluated by counting the number of damaged fruits at the harvest period in late June.

In Section C, the petal fall treatments were applied on March 27. Continuous rains during late February and early March prevented spray applications and the timing of this treatment was late. The inclement weather also affected the mealybugs, as no activity was observed prior to mid-March. The materials used at the petal fall stage were applied without oil, and an average of 650 gallons was applied per acre.

All plots, fall, winter, and spring, were checked for the presence of mealybugs on the fruit at harvest. Six hundred fruits were examined per treatment, and fruit was picked at random from the trees. The fruits with mealybug present, or those showing honeydew and black fungus, were recorded as infested.

In general, the fall and winter treatments were less effective than the spring sprays. The mealybug crawlers are well protected, not only by their location, but by the waxy fibers in the old egg sac, and it is virtually impossible to wet all the colonies. The fall treatments were not as effective as the winter, probably because the presence of foliage made it difficult to obtain bark coverage. The fall and winter counts of crawler mortality did not correlate well with the final fruit counts. The technique of examining colonies was not too feasible, as the number of living mealybugs depended upon how well the colony was protected by the bark. It was not possible to select colonies with the same degree of protection. It was possible, however, to eliminate some materials that did not effectively control the crawlers. As an

example, malathion gave a very poor kill in the fall spray, and therefore that material was not used during the winter or spring.

Of the compounds used, parathion and Diazinon gave the best control, regardless of the timing of treatments. Trithion, Phostex, and Sevin, although reducing fruit damage below that of the checks, did not compare with either parathion or Diazinon.

None of the sprays caused any serious phytotoxic effects to the trees, although the fall sprays in combination with oil caused a little foliage damage. These results are preliminary and additional plot work is planned for the 1959 season. It may be possible that treatments more closely timed to the first or second generation will give better control. With present knowledge, a petal fall spray of either parathion or Diazinon seems the most feasible method of control.

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PINE ROOTS

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were removed from the water baths and the seedlings carefully washed from the sand. The new roots, which had just started to harden—but could be recognized as new roots—were counted and those 0.5" and longer were measured. The air temperature in the greenhouse did not fall below 68°F at night and with but few exceptions did not exceed 95°F during the day. Thus the seedling roots were exposed to a constant temperature, an abundant supply of moisture and nutrients, and the top was exposed to a varying air temperature and a changing photoperiod.

The 1956-57 series was handled in the same fashion except that sponge-rock was substituted for the sand.

Findings

Seedlings from Zone V seed grown at the Mt. Shasta Nursery behaved differently than seedlings from Zone III seed grown at Placerville, although both groups showed a pronounced seasonal periodicity in root elongation and root initiation when transferred at monthly intervals to the greenhouse. Root elongation on seedlings from both zones occurred from September through May and was absent, or of a limited nature, from June through August with the peak occurring on Zone V seedlings in May and on Zone III seedlings two months

earlier in March. Some root initiation was evident from September to June but was prominent on Zone V seedlings only during April and May and on Zone III seedlings only from December to May.

The seasonal ability to initiate roots might on occasion be an important factor in determining the relative ability of fall and spring planted seedlings to survive. In the process of lifting, storing, shipping, and planting a number of the short laterals are destroyed. If it is a spring lifted seedling it will readily regenerate a number of new laterals some of which will then rapidly elongate; if lifted in the fall few if any new laterals will be formed.

Although Zones III and V stock showed significantly different behavior the difference must be interpreted with caution. Obviously, different lots of two year old ponderosa pine seedlings can be expected to perform differently when field planted. However, whether or not the difference in these two particular lots was due to the seed zone, the climate in which they were grown, the way they were lifted, the kind of temporary storage, the shipping conditions, or some unrecognized factor can not be determined from available data.

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RICE

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along with a conductance value of 4.8 millimhos—just over the saline threshold. Iron sulfate clearly increased yields but production was low regardless of iron treatment. Whether the poor performance was due to high sodium, to high salinity, or to both is not known at present.

Soils where rice fails are calcareous and characterized by a high pH, along with a relatively low salinity. Rice plants die of iron deficiency as seedlings because of low iron-supplying power of the soil, which seems to be associated with high pH under flooded conditions.

The use of ferric sulfate appears an effective means of raising rice production to economic levels on high pH, non-saline soils which occur as localized spots in many fields in Glenn and Colusa counties. Where high salinity is encountered ferric sulfate treatments may not be expected to be effective until the soluble salt content of the soil is reduced by leaching.

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