

SOIL FERTILITY

by

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While the main subject is soil fertility, I am going to confine my remarks this morning to the study that was undertaken by Dr. M. A. Radwan and G. L. Crouch, of Forest Sciences Laboratory, Pacific Northwest Forest and Range Experiment Station and myself, as manager of the Webster Nursery in Olympia.

The study was initiated to test the reaction of various forms of nitrogen fertilizer to the palatability and acceptance by the various treatments on seedlings to deer. While the test on the animals was very inconclusive a great deal of information has been extracted from the study that is of benefit to nursery management. Basically the relative value of ammonium nitrate and urea as nitrogen sources for Douglas-fir seedlings at the Webster State Forest Nursery, in Western Washington, was determined. Responses to nitrate and urea were essentially the same, and both fertilizers were superior to ammonium. Our limited experiments, lack of information in the literature, and the well-established importance of nitrogen nutrition for Douglas-fir suggest that further investigation is needed to establish the nitrogen sources, favored by the species under different conditions.

Each nursery has to make their own determination based on their particular soil requirements, and the species of trees that they are raising, and while we have done a great deal of work with various fertilizers to our knowledge it was never steady which was made to check the differences of the effects of the nitrogen sources applied in forest nurseries.

One-year old Douglas-fir seedlings grown from a low-elevation seed source at the Webster State Forest Nursery near Olympia, Washington, were selected in March 1967. The seedlings, in nine 4 by 165 foot nursery beds, were fertilized at sowing in April 1966, with the Nursery's standard ammonium phosphate-sulfate fertilizer (16-20-0) at the rate of 300 pounds per acre. Average seedling height was about 8 centimeters and stocking within all beds was relatively uniform with an average of 45 seedlings per square foot.

Three commercial fertilizers in granular form were tested. These fertilizers ammonium sulfate, calcium nitrate, and urea supplied nitrogen in the form of a cation, an anion, and an undissociated molecule, respectively. Each fertilizer treatment was replicated three times, and treatments were assigned to the nine beds at random. In May and again in September, the fertilizers were broadcast with a tractor-drawn spreader at the Nursery's standard rate of 50 pounds of nitrogen per acre. In both the ammonium sulfate and urea treatments, seedlings received the assigned treatment plus calcium sulfate containing calcium equivalent to that in the calcium nitrate treatment. Thus, the sulfate ion was the only variable among the tree treatments. This imbalance was not considered serious, since the sulfate level was apparently adequate in the nursery soil and because no special need of it by Douglas-fir is indicated in the literature. Furthermore, it was impossible to completely balance the treatments.

Response to fertilization was evaluated while seedlings were still in the beds. Color of the trees was compared visually, and at bimonthly intervals, seedling heights were determined by measuring 30 trees chosen at random from each replication.

In November, sample trees from each of the nine beds were lifted from each treatment and were used for subsequent determinations of dry weights, and out-planting performance, respectively.

Effects of treatments on survival and growth of out-planted stock were evaluated in an exclosure near the Nursery.

Visual color comparisons in the nursery indicated differences between seedlings of the different treatments. Trees fed nitrate or urea were darker green than those of the ammonium treatment. Color differences were evident approximately 3 weeks after the first fertilization in May and continued essentially uncharged until lifting in November.

Over the growing season, three main stages of seedling height growth were evident: (a) very rapid growth from May to July, (b) rapid growth from July to September, and (c) a leveling off stage from September to November.

Data from the nursery, laboratory and exclosure indicate definite differences in the value of the three different forms of fertilizer nitrogen for Douglas-fir seedlings. Under conditions of the experiments, responses to urea and nitrate were essentially the same, and both fertilizers were superior to ammonium. Our limited studies and known differences between the three nitrogen fertilizers in effects on solid pH, losses through leaching and volatilization, susceptibility to transformations through microbial and enzymatic action, fixation by soil particles, and availability characteristics do not indicate a definite basis for the differential effect among the nitrogen sources.

We believe that differences among treatments in our results is of sufficient magnitude to justify consideration in nursery management practice. However, since our tests were not extensive, we suggest additional experiments to verify the results before adopting a fertilization regime based upon one of the nitrogen sources.