SULFUR DEFICIENCY IN NURSERY SEEDLINGS MAY BE CAUSED BY CONCENTRATED FERTILIZERS

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During the 1960 season several areas of chlorotic pine seedlings developed throughout the Auburn nursery. Some areas appeared to be the usual elusive "summer chlorosis," with seedlings yellow or almost white toward the top but not stunted. Other chlorotic areas seemed to be "sawdust-burned" or nitrogen-deficient from excessive raw sawdust applications, with seedlings stunted and dark yellow.

A series of plots was located within areas of both types of chlorosis to determine the remedial effectiveness of ammonium sulfate, potassium chloride, and ammonium nitrate. None of these compounds had any effect on the summer chlorosis. The only plots that showed any response were those in the supposedly nitrogen-deficient areas which received ammonium sulfate. These plots turned a normal shade of green and began height growth.

The fertilizer record at the Auburn nursery revealed that for the past 3 years diammonim phosphate had been used as the only phosphorus source, instead of the usual superphosphate. This led to speculation that the chlorotic seedlings were deficient in sulfur, since diammonium phosphate does not contain sulfur whereas superphosphate does.

It has been a common practice during the past few years to apply more concentrated fertilizers to forest tree nurseries in the South, and these fertilizers are relatively pure when compared to low concentrates such as superphosphate. For instance, superphosphate contains 18 to 20 percent P_2O_5 and 40 to 50 percent calcium sulfate. Under circumstances where sulfur is deficient, the calcium sulfate can be just as important as the P_2O_5 even though the calcium sulfate is sometimes thought of as an impurity.

A second series of plots was set up in the supposedly nitrogen-deficient loblolly pine seedlings, to test the effectiveness of ammonium sulfate, ammonium nitrate, sodium sulfate, sodium nitrate, and ammonium chloride against this type of chlorosis. Within two weeks the plots receiving ammonium sulfate and sodium sulfate turned a normal shade

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of green and began height growth. Plots that did not receive sulfate remained stunted and yellow. The average heights of treated seedlings on Aug. 12, 1960, three weeks after treatments were applied, gave the following results:

Treatment	*Av. Ht. of Seedlings (cms.)*
NH_4NO_3	11.06
$NaNO_3$	12.18
$(NH_4)_2SO_4$	13.93
$(Na)_2SO_4$	13.40
NH_4CL	10.95

Seedlings on all plots had changed to a normal green color by mid-October; however, the differences in foliage density and height remained obvious until the seedlings were lifted. It is believed that this eventual change in color resulted as the seedlings became larger and - their root systems obtained sulfur from deeper soil layers and greater lateral areas.

The results of this study and many agronomic experiments emphasize the need for complete records of fertilization practices in forest tree nurseries in order to be certain that seedlings get enough of all necessary elements. It is perfectly reasonable to use concentrated fertilizers to increase the efficiency of nursery operations; however, such practices may lead to nutrient deficiencies of both macro and micro elements that are not present in the concentrated fertilizers. Some provisions must be made to recognize these problems and avoid or correct them if they occur.