CHLOROSIS OF LOBLOLLY PINE SEEDLINGS

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One of the problems in the production of pine seedlings in most nurseries throughout the Southeast is a chlorosis, sometimes referred to as "white top" or "summer chlorosis." This chlorosis appears on the primary foliage at about 6 weeks of age, although it has been observed both earlier and later in pots in the greenhouse. The youngest or developing needles are affected first and if the chlorosis becomes severe it is likely to succumb. Visually the chlorosis appears as follows: the upper one-third to one-half of the seedling foliage becomes completely chlorotic, the foliage at the very tip being pale-yellow (2.5 GY 8/6 to 8/8 on the Munsell color chart) with a gradation down the stem to a yellowish-green (2.5 GY 7/6 to 6/6) and the lower two-thirds to one-half being light-green (7.5 GY 6/4 to 5/4). If chlorosis persists, the needles become necrotic, the necrosis progressing from the tips to the base. The chlorosis differs from N deficiency in that the latter appears as a light-green or yellowish-green color over the whole plant. Chlorotic seedlings are generally found to have poorly developed root systems; whether this is the cause or the result of the chlorosis is not known.

The chlorosis is thought to be associated with a disturbance of the iron nutrition of the plant (1, 2). However, a chlorosis may be the result of many different factors acting singly or in combination. These may include the following factors (2).

1. Nitrogen deficiency.
2. High levels of NO_3-N.
3. Low Fe and Zn levels in the soil.
4. High levels of Mn, Cu, and Zn in the soil.
5. High levels of phosphate in the soil.
6. Poor soil aeration.
7. Over irrigation.
8. Certain organic matter additions to the soil.
9. Root damage by nematodes or other organisms.

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10. Viruses.

11. Bicarbonate in the irrigation water.

12. Low or high temperatures.

13. High light intensity.

14. Unbalanced cation ratios.

15. Calcium carbonate in the soil.

Observations in nurseries and experimental work in both nurseries and the greenhouse indicate a large number of circumstances under which chlorosis may develop. Of the factors listed above, the chlorosis is clearly not a nitrogen deficiency. Actually, high rates may cause it to develop and it is possible that nitrate N is involved. Fastors 3, 4, and 5 have all been found to cause chlorosis of loblolly pine but no clear cut pattern is apparent that will permit diagnosis of the problem by soil or tissue testing.

Inadequate aeration and over-irrigation (factors 6 and 7) usually cause chlorosis in localized spots and can usually be prevented by proper management. Organic matter additions (factor 8) have, on occasion, alleviated chlorosis but the effects have not been consistent. Root damage by nematodes and other organisms (factor 9) and viruses (factor 10) may be involved, but again there is no good evidence. None of the remaining factors is likely to be involved under conditions of good management.

SUMMARY

The summer chlorosis of loblolly pine appears to be the result of an Fe deficiency. However, experimental results indicate that no single factor is responsible; in fact, it has not been clearly established that Fe deficiency is the main cause. However, we have observed the chlorosis of loblolly pine under the following conditions:

1. Low levels of Fe in nutrient solutions.

2. High levels of Mn in nutrient solutions containing high levels of NO_3-N but not when solutions contained equal amounts of NH_4- and NO_3-N.

3. Additions of high rates of Mn, P, and Cu to soils.

4. High soil pH.

5. High rates of N application.

The chlorosis was alleviated in some cases by the use of NH_4 forms of N, by the application of sawdust or Fe chelate, or by fumigation with methyl bromide.

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