Diagnosing Mineral Deficiency By

Foliar Fertilization

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Nurserymen are often dismayed over unusual colorations and other abnormal characteristics of seedlings throughout the growing season. Most of these abnormalities disappear with time and don't seem to cause permanent damage. However, the nurseryman usually wants to know such things in order to prevent possible future problems.

An abnormal plant part may be caused by disease, insect injury, extreme climatic conditions, chemical toxicity, mechanical injury, or mineral deficiency. In some cases, the direct cause of the plants' appearance may be secondary rather than primary. For instance, insect damage to the root system may 'restrict nitrogen uptake of the seedling and result in a chlorotic condition of the foliage. Fertilization of the seedling foliage with nitrogen would probably correct the chlorosis (thereby indicating a nitrogen deficiency) but would not reveal the primary problem of insect damage.

This article's purpose is to acquaint the nurseryman with foliar fertilization as a method of diagnosing mineral deficiency in tree seedlings. The author has used nitrogen, phosphorous, potassium, magnesium, sulfur, and iron compounds successfully in correcting deficiencies in loblolly pine seedlings for a short time. There is reason to believe that practically any element can be introduced into the plant by foliar fertilization. However, fertilization techniques may vary from plant to plant. Many factors affect the absorption of nutrients by foliage. Some that favor absorption and may be used to the nurseryman's advantage are vigorous new growth, high humidity, and normal growing temperature.

The fertilization procedure used by the author with loblolly pine seedlings is to bend the seedling top over into a glass containing the desired solution; place a plastic bag over the wet foliage, and close the mouth of the bag around the seedling stem. The bag is left on the foliage 24 to 48 hours to keep the solution salts in condition to penetrate the pine needles. It is probably best to apply the solution in the late afternoon or evening to avoid some of the heat buildup within the plastic bag. When the bag is left on the foliage in' strong sunlight, it would be wise to shade the seedling. If the seedling does not respond to treatment within 1 week, the solution should be applied again. With hardwood seedlings, probably not as much effort is required to introduce nutrient salts into the foliage and the plastic bag can probably be eliminated.

Many publications describe the mineral deficiency symptoms of field crops and forest trees (1, 2, *3, 4, 5, 6, 7, 8,* 9). These are helpful for narrowing the field when searching for a deficient element. However, all plants do not show exactly the same symptoms for a given deficiency, and the . same plant may exhibit several different symptoms as it progresses from slight to extreme deficiency. Some fairly universal symptoms can be used as a starting point for diagnosis. Nitrogen, sulfur, `magnesium and iron deficiencies all cause a yellow-green to yellow foliage coloration. Calcium and boron deficiencies cause growing tips to die, and phosphorous and potassium deficiencies cause purple and bronze discolorations of foliage. Using symptoms as a guide, the nurseryman can often limit the number of fertilizer solutions to be tried.

Table 1 shows some of the more common chemicals that may be used as foliage fertilizers. There are others that can be used as well. Many can be obtained at any pharmacy. The quantity column shows the amount of the chemical to add to one quart of

TABLE 1.—*Some chemicals and quantities used to prepare foliar fertilization solutions.*[1]

Chemical Source[2]			Quantity[3]		
Elements	*Name*	*Formula*	*Ounces*	*Grams*	*Teaspoons*
Nitrogen	Urea	NH_2CONH_2	0.2	5.0	1-1/2
Nitrogen	Ammonium nitrate	NH_4NO_3	0.3	8.0	2
Nitrogen and phosphorus	Monoammonium phosphate	$(NH_4)\ H_2PO_4$	0.3	8.0	1-1/2
Phosphorus	Orthophosphoric acid	H_3PO_4	0.1	3.0	1/2
Phosphorus and potassium	Monopotassium phosphate	KH_2PO_4	0.4	10.0	1-1/2
Potassium and sulfur	Potassium sulfate	K_2SO_4	0.4	10.0	1-1/4
Potassium	Potassium chloride (muriate potash)	KCL	0.4	10.0	2
Calcium	Calcium chloride	$CaC1_2$	0.4	10.0	2-1/4
Calcium	Calcium hydroxide (slaked lime)	$Ca(OH)_2$	0.2	5.0	2-3/4
Magnesium and sulfur	Magnesium sulfate (Epsom salts)	$MgSO_4.7H_2O$	0.8	20.0	4-3/4
Magnesium	Magnesium chloride	$MgCl_2.6H_2O$	0.4	10.0	2-1/4
Iron and sulfur	Ferrous sulfate (copperas)	$FeSO_4.7H_2O$	1.0	28.0	4
Copper and sulfur	Copper sulfate	$CuSO_4.7H_2O$	0.3	8.0	1-1/4
Zinc and sulfur	Zinc sulfate (white vitriol)	$Zn\ SO_4.7H_2O$	0.2	5.0	1
Manganese and sulfur	Manganous sulfate	$MnSO_4.4H_2O$	0.1	3.0	3/4
Boron	Sodium borate (borax)	$Na_2B_4O_7.IOH_2O$	0.1	3.0	1-1/8
Molybdenum	Sodium molybdate	Na_2MoO_4	0.0025[4]	0.07[4]	1/16[4]

[1] Add a few drops of surfactant, spreader, or detergent to each solution.

[2] Chelated elements may also be used. Solution concentrations for foliar application can be obtained from the manufacturer.

[3] Quantity added to 1 quart of water.

[4] Approximately the amount to barely cover one surface of a dime.

water. It will also be necessary, in most cases, to add a spreader, surfactant, or detergent to the solution in order to spread it uniformly over the leaf surface.

Some of the chemicals will provide more than one nutrient element, and care must be taken to interpret results correctly. For instance, let us say that some seedlings exhibit an abnormal yellow foliage coloration and iron or sulfur deficiency is suspected. If a solution of iron sulfate is applied to the seedlings and the chlorosis is corrected, then it is impossible to say whether iron or sulfur was deficient. However, if you apply iron sulfate to one group of chlorotic seedlings and potassium sulfate to a comparable group, you should be able to differentiate between iron and sulfur response. If both the iron sulfate and potassium sulfate solutions correct the chlorosis, the deficiency was probably sulfur. If the iron sulfate alone corrects the chlorosis, the deficiency was probably iron.

Foliar fertilization will not reveal the cause of all your seedling abnormalities, but it should be useful in some cases and help guide you toward the solution of many nutrition problems.

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