Manganese compounds harmful to planting stock under some soil conditions

S.H. Slaton and J.G. Iyer [1,2]

Michigan studies show that harmful influences of manganese- containing chemicals on tree seedlings are directly related to soil moisture and aeration.

1 Superintendent of the J.W. Toumey Nursery, USDA Forest Service, and lecturer in soil science, Univ. of Wisconsin, respectively.

2 Research supported in part by the College of Agricultural and Life Sciences, University of Wisconsin, in collaboration with the USDA Forest Service and the Wisconsin Department of Natural Resources

The recent incidence of needle cast disease of certain conifers, caused by the fungus Lophodermium pinastri, required the use of the Maneb (manzate) fungicide, a compound containing approximately 17 percent elemental manganese. While spray treatments with this chemical did provide satisfactory control of the disease (3), the addition of a large amount of manganese raised the possibility of its unfavorable influence on the availability of other plant nutrients, the efficacy of mycorrhiza-forming fungi, and survival potential of tree planting stock.

Because very little information exists on the effect of manganese compound. on the properties of either nursery soils or produced reforestation material, the USDA Forest Service conducted a systematic study of this problem in the J. W. Toumev Nursery at Watersmeet, Mich. The investigation included soil and foliar analyses and observation of the effect of Maneb and manganous *sulfate (MnSO4)* under different levels of soil moisture and aeration

(2). The maintenance of constant moisture and air supplies was achieved Its the use of subirrigated cultures (fig. 1). The capillary rise of water imparted to the root zones moisture-air contents ranging from a near saturation and a critical air deficiency in the short cylinders to field moisture capacity and an adequate aeration in the bong cylinders (table 1).

Following planting of 2-year-old red pine seedlings, the cultures were sprayed weekly with the Maneb at rates of 12 and 24 pounds per acre. The treatments were continued for 8 weeks, beginning July 2. 1970. Manganous cultures received applications of $MnSO_4 \cdot H_2O$ at rates of 200 and 400 pounds per acre.

Analyses of soils treated with either chemical failed to show any effect of the treatments on the content of extractable manganese or other fertility factors. On the other hand, analyses of tree needles revealed that the treatments produced a trifold increase in the foliar concentration of manganese as well

TABLE 1.—*Contents of water and air in the root zones of subirrigated cultures (bulk density and porosity of the soil are 1.44 and 44.6 percent, respectively)*

Distance from the ground water table	Content of water			Air content
	Culture A	Culture B	Average	
Inches	*Percent by volume*			*Percent*
30	10.2	10.8	10.5	34.1
18	26.4	19.6	23.0	21.6
6	41.9	41.7	41.8	2.8

as aluminum-two elements with pronounced fungicidal properties (table 2). This increase imparted to red pine the foliar composition characteristic of jack pine, a tree of a considerable inherent resistance to *Lophodermium* fungi (1).

The growth of trees in subirrigated cultures disclosed that the harmful influence of Maneb and manganous sulfate is related directly to the degree of rout zone saturation with water and the corresponding level of aeration. As long as the difference between soil porosity and the volume of water was less than 18% percent (table 1), Maneb treatments at a week rate as high as 24 lbs./a. and a direct application of 400 lbs./a. of manganous sulfate produced no adverse effect on availability of nutrients, development of mycorrhizal shoot roots, morphology of tree seedlings. and their growth potential. The latter attribute was established on the basis of 1-year field performance trials (table 3).

Application of either Maneb or manganous sulfate to soils with an inadequate air content produced marked deterioration in the makeup of test plants, their growth rate and survival.

Results of the study indicate that the use of 'stanch fungicide or other manganese-containing chemicals requires careful control of artificial irrigation, particularly in treatments of soils of a low porosity and field moisture capacity exceeding 20 percent by volume.

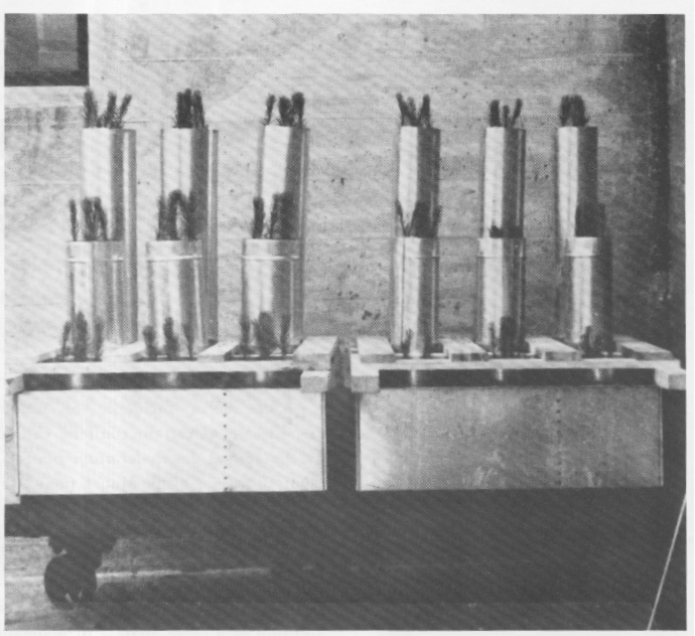

Figure 1.—Subirrigated cultures were used to maintain constant moisture and aeration.

Literature Cited

1. Iyer, J.G., E.E. Schulte, and G.W. Randall. 1971. Relationship between foliar composition of red pine and jack pine seedlings and vulnerability to Lophodermium needlecast disease. Plant and Soil, 35:213-216. (Hague, Netherlands).

2. Iyer, J.G. and W.L. Trautmann.\1967. Effect of DMTT on the growth of Monterey pine at different contents of soil moisture. Weeds 15 (3):282-284.

3. Nicholls, T.H. and D.D. Skilling. 1970. Lophodermium pinastri outbreak in Lake States forest nurseries. Plant Dis. Rep. 54 (9): 731-733.

TABLE 2.—*Foliar composition of 3-year-old red pine seedling raised on control and maneb fungicide treated beds (absorption spectrophotometric analyses by the Wisconsin Alumni research Foundation Laboratory)*

Determined characteristics	Untreated stock	Maneb treated stock
N, pct.	1.35	1.34
P, pct.	0.11	0.18
K, pct.	0.55	0.62
Ca, pct.	0.37	0.30
Mg, pct.	0.10	0.09
Mn, p/m	167.00	545.00
Fe, p/m	110.00	250.00
Al, p/m	146.00	420.00
B, p/m	5.50	9.50
Zn, p/m	69.00	123.00
Cu, p/m	Tr	Tr
Ba, p/m	5.75	8.70
Sr, p/m	2.85	1.95

TABLE 3.—*Morphological features of average 3-year-old red pine seedlings following 1-year growth on performance test plots*

Depth to Water table	Length		Stem diameter	Weight		Top-root ratio	Mycorrhizal short roots
	Tops	Roots		Tops	Roots		
Inches	*Cm.*		*Mm.*	*G.*			
			Control cultures				
30	24.0	21.1	2.7	2.50	1.02	2.4	Ample
18	24.0	19.1	2.9	3.51	1.34	2.6	Abundant
6	19.8	14.5	1.6	1.30	0.54	2.4	Sparse
			Maneb sprays at weekly rate of 12 lbs/a				
30	24.0	17.6	2.4	2.96	1.26	2.3	Abundant
18	26.4	23.6	2.8	4.04	1.77	2.3	Abundant
6	17.6	18.5	2.3	2.22	1.08	2.0	Ample
			Maneb sprays at weekly rate of 24 lbs/a				
30	23.8	18.4	2.6	3.36	1.33	2.5	Abundant
18	24.8	18.8	2.4	3.38	1.12	3.0	Abundant
6	15.3	12.3	1.5	0.87	0.27	3.2	Sparse
			Two direct applications of manganous sulfate of 200 lbs/a each				
30	22.0	21.2	2.1	2.16	0.85	2.5	Abundant
18	21.5	22.0	2.2	1.93	0.62	3.1	Abundant
6	----------			No survival		----------	

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Symposium on Containerized Tree Seedlings

New developments in a better way of growing forest tree seedlings will be the subject of a symposium in Denver, Colo., Aug. 26-29. 1974.

The North American Containerized Forest Tree Seedling Symposium, sponsored by the Great Plains Agricultural Council and several national forestry groups of the U.S., and Canada. will bring together specialists in this seedling production process from both countries to present information on latest developments and techniques.

More on Radiographs

After reading the article 'New techniques for reading seed radiographs save time" (in TPN 24(3), p. 14). D. G. Edwards of the Canadian Forestry Service, Pacific Forest Research Centre, Victoria, B. C., writes that his laboratory uses a frame similar to that described by Professor Duffield. His description follows:

"We stretch a sheet of adhesive film, such as the decorator vinyl coverings sold in hardware stores, on the underside (sticky side up). The clear, transparent type of film is used. When the radiograph has been developed, the trayplus-seeds can he placed directly on top of the x-ray negative and the seeds and their images matched up. Illumination from below, by means of a light table, facilitates this.

Individual seeds showing particular characteristics can he identified on the radiograph by circling with a felt-tipped pen or chinagraph pencil. With the transparent film base of the tray. the markings on the radiograph can easily be seen on the light table and the respective seeds identified. For very small seeds, and where the seeds are tightly packed on the tray, we find that staggering the seeds slightly to one side, rather than precisely lining them up with their images, permits easier viewing of the markings on the radiograph.

This method has been used in this laboratory for several years and offers two additional advantages: 1) It can be used by personnel who have difficulty using a stereoscope and, 2) it avoids the $150-200 outlay for the stereoscope or drafting machine. The method works on all sizes of x-ray film: we routinely use an 8" x 10" tray and matching film. It can also be used with Polaroid prints and the new radiographic paper (Kodak). The key is the transparent adhesive film forming the base of the tray."

Nobel Prize Winner Talks of Forestry

Dr. Norman E. Borlaug. winner of the 1970 Nobel Peace Prize for his work in developing high yield varieties of wheat, took a week-long tour of national Forests in Idaho, Eastern Oregon, and Montana last fall. In a Montana talk, Dr. Borlaug praised the success of Forest Service researchers - developing a disease resistant strain of the Western White Pine Tree - and noted that U.S. forestry in general is a leader in world research and management.

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