CONCENTRATION OF MICRONUTRIENTS IN FOLIAGE OF ASPEN (*POPULUS TREMULOIDES* MICHX.) IN MANITOBA

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INTRODUCTION

Trace element deficiencies can have a casual relation to many of the foliage discolorations observed in forest trees. One instance of where this was thought to be true was in trembling aspen in the prairie-forest transition region of Manitoba, where pockets of trees with chlorotic leaves have been observed yearly since 1966. Observations of selected locations and tagging of individual trees indicated that chlorosis occurred in the same trees and the same areas every year. Symptoms were observed yearly in the Anola, Interlake, Westbourne, Russell, and Bowsman areas where calcareous soils were known to be present (Manitoba Soil Survey Reports) but no such symptoms were observed on upland forest soils found in nearby regions of the mixed-wood type (Rowe, 1959).

Since information on micronutrient levels is scarce, especially for forest trees of the prairie region, this preliminary investigation was conducted.

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MATERIALS AND METHODS

At the south edge of the Porcupine Forest Reserve near Bowsman in western Manitoba, soil and leaf-tissue samples were collected in July, 1969 in a location where pockets of chlorotic trees were prevalent and at a point 4 miles away in a stand uniformly free of the symptoms. At each location, soils from different horizons as well as leaves from three branches in the mid-crown of three trees were collected. Similar samples were collected from chlorotic trees and apparently normal ones at Anola in eastern Manitoba. All of the stands sampled were young, less than 40 years of age.

Soils were analyzed for pH (1:1 soil-to-water suspension), calcite, and dolomite (Skinner et al., 1959). Exchangeable manganese, calcium, and magnesium extracted with 1N NH_4OAc of pH 7 (Jackson, 1958) and iron, copper, and zinc extracted with 1% disodium EDTA were determined by a Perkin-Elmer atomic absorption spectrophotometer, model 303 (Anonymous, 1968). Leaf tissues were air-dried, dry-ashed at 450°C and extracted with 10 ml of 1N HCl per gram of sample. The atomic absorption spectrophotometer was used to analyze leaf extracts for iron, manganese, copper, and zinc.

RESULTS AND DISCUSSION

Levels of iron, manganese, copper, and zinc in the foliage are shown in Table 1. Except for samples from the upland forest site at Bowsman, levels of iron and manganese appear low when compared to values reported for various tree species (Stone, 1968). Copper levels appear low to intermediate with the exception of levels found in chlorotic trees

Table 1. Concentration (ppm) of micronutrients in the aspen foliage from Bowsman and Anola, Manitoba. July, 1969.

Location*	Iron	Manganese	Copper	Zinc
A (I)	59.7^{b}	20.7^{a}	3.7^{a}	74.3^{b}
(II)	52.3^{b}	37.7^{ab}	5.3^{a}	79.0^{b}
(III)	53.0^{b}	47.3^{b}	3.0^{a}	83.3^{b}
B	67.3^{b}	84.7^{c}	2.3^{a}	126.0^{c}
C (I)	23.7^{a}	22.7^{a}	6.0^{a}	27.7^{a}
(II)	33.7^{ab}	26.0^{a}	5.0^{a}	74.3^{b}

*Sampling locations: A. Porcupine Forest Reserve, near Bowsman, Manitoba; (I) (II) pockets of chlorotic trees; (III) pocket of trees with normal green color. B. Porcupine Forest Reserve, stand with no chlorotic trees, four miles from location A. C. Anola, Manitoba; (I) chlorotic trees, (II) normal green trees.

^{abc}Duncan's Multiple Range Test: Means followed by the same letter in a column are not significantly different at P = 0.05.

at Anola. Zinc levels appear high. Although aspen accumulated zinc (Gerloff et al.,1966), a concentration of only 28 ppm of the element was found in the chlorotic trees at the Anola site. At Bowsman, the foliage in the stand with no chlorotic trees contained 126 ppm zinc. This is consistent with the findings of Gerloff et al. (1966), who reported a concentration of 127 ppm zinc in aspen foliage. Stone (1968) pointed out that excess zinc produces a chlorosis similar to that of iron deficiency. Significant differences among sampling locations were observed for iron, manganese, and zinc. Differences in micronutrient levels in groups of trees at the same location were not statistically significant, except for manganese at the Bowsman location where chlorotic trees were present.

Soil analyses made in conjunction with the foliar analyses showed two main features, namely: high levels of alkaline-earth carbonates in soils where chlorotic trees were located (Table 2) and relatively very low levels of iron, manganese, and zinc in Anola soils. It appears that the observed foliar symptoms may have been due to manganese deficiency, possibly iron deficiency or a combination of these deficiencies. These elements did not appear to be deficient in the soil, at least in the Bowsman area but could have been rendered unavailable by alkaline-earth carbonates as indicated by Read and Sheldrake (1966). Stone (1968) has emphasized that calcareous soils are the most common sources of iron deficiency problem in forest areas. Within an area, differences in symptoms not reaily explainable by soil or tissue analyses were more likely attributable to interclonal variation (Barnes, 1966) in response to soil conditions.

Table 2. Results of analysis of soils from Bowsman and Anola, Manitoba; July, 1969.

Location*	Depth (inches)	pH	Alkaline-earth carbonates (%)		Exch. Ca (meq/100g)	Exch. Mg (meq/100g)	Fe (ppm)	Mn (ppm)	Cu (ppm)	Zn (ppm)
			Calcite	Dolomite						
A (I)	0-5	6.7	0.2	0.3	65.5	24.3	401	29.0	4.7	25.3
	5-10	6.9	0.1	0.2	29.1	12.6	838	6.6	3.5	3.0
	10-16	7.3	0.1	3.6	18.9	10.9	269	1.6	4.2	0.8
(II)	0-6	7.2	0.3	1.0	63.6	7.8	413	30.8	6.5	47.8
	6-14	7.3	0.4	0.2	18.9	5.1	643	7.3	4.9	5.5
	14-20	7.4	0.5	2.5	15.3	7.3	194	1.8	7.5	0.6
(III)	0-6	6.0	0.0	0.0	41.2	11.9	1399	41.6	5.1	4.6
	6-10	7.0	0.4	1.9	21.2	8.8	608	7.4	5.2	0.8
	10-12	7.8	3.9	19.6	25.0	6.4	109	1.9	3.2	1.1
	12-18	8.1	18.3	29.0	24.7	4.7	23	0.8	0.8	0.3
B	0-5	6.2	0.0	0.0	32.8	6.7	491	50.9	3.7	39.3
	5-9	5.8	0.0	0.0	3.4	1.2	206	13.9	0.3	6.4
	9-14	6.0	0.0	0.0	10.2	5.7	248	25.7	0.5	0.8
C (I)	2-5	8.4	18.0	26.6	37.2	11.0	38	1.4	2.4	2.8
(II)	2-5	8.4	18.4	35.0	36.4	6.7	33	1.0	1.3	1.0

* Sampling locations: See Table 1.

Further investigations of trace-element nutrition of trembling aspen may help to explain its poor growth on many sites. Foliar application of trace elements to test plots will be necessary in certain areas to confirm their deficiencies.

REFERENCES

Anonymous. 1968. Analytical methods for atomic absorption spectrophotometry. Perkin - Elmer, Norwalk, Conn.

Barnes, B.V. 1966. The clonal growth habit of American aspens. Ecology 47: 439-447.

Gerloff, G.C., D.G. Moore, and J.T. Curtis. 1966. Selective absorption of mineral elements by native plants of Wisconsin. Plant and Soil 27: 393-405.

Jackson, M.L. 1958. Soil chemical analysis. Prentice-Hall, Inc., Englewood Cliffs, N.J. 498 p.

Manitoba Soil Survey. Soils Report Nos. 5 (1953), 6 (1956), 7 (1957), 12 (1961), and 13 (1962). Queen's Printer, Winnipeg, Manitoba.

Read, P.E., and R. Sheldrake, Jr. 1966. Correction of chlorosis in plants grown in Cornell peat-like mixes. Proc. Amer. Soc. Hort. Sci. 88: 576-581.

Rowe, J.S. 1959. Forest regions of Canada. Can. Dep. N. Aff. and Nat. Resour. Forest. Br. Bull. 123. 71 p.

Skinner, S.I.M., R.L. Halstead, and J.E. Brydon. 1959. Quantitative manometric determination of calcite and dolomite in soils and limestones. Can. J. Soil Sci. 39: 197-204.

Stone, E.L. 1968. Microelement nutrition of forest trees: a review, p. 132-175. In G.W. Bengtson et al. (eds.) Forest fertilization-theory and practice. Tennessee Valley Authority, Muscle Shoals, Ala.