Leaf Necrosis of Roadside Sugar Maple in Ontario in Relation to Elemental Composition of Soil and Leaves

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ABSTRACT

Injury to leaves of sugar maple trees located 1 to 7.6 m from the pavement of Highway 6, Guelph, Ontario, was examined in relation to the concentrations of certain elements in leaves and soil. Leaves on the side of the tree nearer the pavement (front) were more injured (P=0.01) and contained higher concentrations of sodium and chloride (P=0.01) than those on the side of the tree further from the pavement (back). No significant differences between the front and back of trees were detected in foliar concentrations of nitrogen, phosphorus, or potassium. Sodium concentrations in soil (P=0.01) and conductivity of soil extract (P=0.05) were higher at the front of the tree than at the back. It is concluded that leaf injury was greater at the front of the tree due to the higher concentrations of sodium and chloride in foliage and of sodium in soil at the front of the tree. Phytopathology 63:1426-1427

Additional key word: salt.

De-icing salt has been implicated in decline of roadside maples since high concentrations of chloride (1, 2, 4, 6, 9) or sodium (7) have been observed in symptomatic leaves and high levels of sodium may occur in soil within 20 m of salted roads (5).

We examined 22 mature sugar maple trees (*Acer saccharum* Marsh.) located 1 to 7.6 m from the pavement of Highway 6, Guelph, Ontario. In August 1971, leaves were removed from each tree from the side nearer the pavement (front) and from the side further from the pavement (back) at a height of 3 to 4 m above the ground. Leaf samples were rated according to the following scale of visible injury: 0 = no visible injury; 1 = slight to moderate marginal necrosis; 2 = extensive necrosis, slight defoliation; 3 = extensive necrosis, considerable defoliation.

The leaves were then placed in plastic bags and weighed as soon as possible to determine fresh weight, dried at 80 C for 2 to 4 days, then ground in a Wiley mill fitted with a 40-mesh screen. Sodium and chloride concentrations were determined as previously described (3). Other samples of the ground leaves were digested in concentrated sulfuric acid, cleared with hydrogen peroxide, and analyzed for potassium (atomic absorption), nitrogen and phosphorus (Technicon autoanalyzer).

The soil around 10 trees was sampled. Ten cores 2.3-cm in diam were taken from the upper 10 cm of soil 2 m in front of and 2 m behind each tree. Soil samples were air-dried then extracted with 1 N ammonium acetate. Concentrations of sodium, chloride, and potassium were determined as above.

TABLE 1. Analysis of leaves and soil from the front[a] and back[a] of roadside sugar maple trees

Type of analysis	Mean value		Level of significant difference (P) between means[b]
	Front[a]	Back[a]	
Leaf injury rating	1.6	0.6	0.01
Leaf fresh weight/ dry weight	2.07	2.27	0.01
Foliar Na (g/100 g)	0.263	0.046	0.01
Foliar Cl (g/100 g)	0.76	0.54	0.01
Foliar K (g/100 g)	0.65	0.62	n.s.[c]
Foliar N (g/100 g)	1.59	1.66	n.s.
Foliar P (g/100 g)	0.17	0.18	n.s.
Soil Na (mg/100 g)	17.7	7.3	0.01
Soil Cl (mg/100 g)	55.8	44.6	n.s.
Soil K (mg/100 g)	9.5	13.6	n.s.
Soil conductivity (μmho)	61.9	51.1	0.05

[a] Front = side of tree nearer to pavement, back = side of tree further from pavement.

[b] Analyzed by Student's *t–test* for means of unpaired observations (8, *p.* 73-75).

[c] n.s. = probability of means being different due to chance alone greater than 0.05 (a nonsignificant difference).

Total soluble salts were determined by extracting 5-g samples of air-dry soil in 50 ml of glass-distilled water and measuring the conductivity of the extract with a Barnstead conductivity bridge.

Leaf injury, expressed as visible injury and as degree of desiccation (fresh weight/dry weight) was significantly greater in the front of the tree than in the back (Table 1). Levels of sodium and chloride in foliage and levels of sodium and total soluble salts (conductivity) in soil were significantly greater at the front. The data therefore indicate that de-icing salt contributes to necrosis of leaves of maple trees in the roadside environment in Ontario. Foliar levels of chloride or sodium greater than 0.5% were usually associated with moderate to severe injury. This concurs with previous reports (1, 4, 7, 9).

We found no evidence that sodium and chloride cause leaf injury by inducing deficiencies in essential elements. No significant differences between the front and back of trees were detected in foliar levels of nitrogen, phosphorus, or potassium or in soil levels of chloride or potassium. Similarly, Baker (1) found no relation between leaf injury and foliar levels of calcium, magnesium, or potassium.

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