

Molybdenum Content of Corn Plants Exhibiting Varying Degrees of Potassium Deficiency

Abstract. Leaves from corn plants exhibiting symptoms of potassium deficiency contain considerable concentrations of molybdenum. Applications of potassium fertilizer corrected the deficiency, and a significant reduction in the molybdenum content of the leaves occurred. This inverse relation between potassium and molybdenum has not been reported previously.

Hybrid corn plants growing in the field and showing symptoms of moderate to severe potassium deficiency have been found to contain larger concentrations of molybdenum in their leaves than plants with no visible symptoms of a potassium deficiency (Table 1). Spectrographic analysis (1) revealed about a fourfold increase in molybdenum content in leaves from plants with deficiency symptoms as compared to leaves from normal plants. When grown on a potassium-deficient soil (Hardin silt loam), the molybdenum

content of corn leaves decreased as the severity of potassium deficiency decreased (Table 2). A change in molybdenum content with a change in potassium content did not appear to occur in leaves that did not exhibit symptoms of potassium deficiency.

In an extensive review of the literature (2) the effect of potassium deficiency or potassium fertilization on molybdenum content of plants was not reported.

Potassium deficiency did result in a slight stunting of the corn plants, and this could account for a portion of the increased concentration of molybdenum. Also, the calcium and magnesium content of corn leaves generally increases as the potassium content decreases (see Fig. 1).

Rossiter (3) reported that calcium is probably needed to transport molybdenum from the roots to the tops of plants. Since the amount of calcium in potassium-deficient plants is usually higher than in normal plants, Rossiter's hypothesis may account for the greater amount of molybdenum in the potassium-deficient corn plants.

Although these observations find some support in Rossiter's hypothesis, additional investigations will be needed

Table 1. Molybdenum content of corn leaves from potassium-deficient plants and normal plants (1). A fully developed leaf below the whorl was used for analysis in each instance.

Potassium-deficient plants		Normal plants	
Potassium (%)	Molybdenum (ppm)*	Potassium (%)	Molybdenum (ppm)*
<i>Plants from Cortland, Ohio, sampled on 19 June 1963</i>			
0.97	2.0	2.70	0.5
<i>Plants from Carpenter, Ohio, sampled on 18 June 1963</i>			
.56	4.0	2.49	.9
<i>Plants from Wooster, Ohio, sampled on 3 June 1963</i>			
.52	2.8	1.73	.7

* Molybdenum contents (in parts per million) of deficient and normal plants were significantly different at the 0.01-percent level.

Table 2. Molybdenum and potassium content of corn leaves as affected by the rate of application of potassium fertilizer along the seed at planting. The potassium was applied as fertilizer-grade KCl (60 percent K₂O). Fully developed leaves from below the whorl were taken for analysis (1) when the plants were about 3 feet 6 inches (1 meter) high, on 18 June 1963. The plants were grown at Carpenter, Ohio.

Amount of potassium applied (lb/acre)	Degree of potassium deficiency	Composition of leaves	
		Potassium (%)	Molybdenum (ppm)†
0	Severe	0.57	4.0
33*	Slight	1.79	1.2
66	None	2.28	0.9
100	None	2.49	0.9

* 33 lb/acre is equivalent to 36 kg/hectare.
† Duncan multiple-range test.

to determine the exact cause of high molybdenum content in potassium-deficient corn plants.

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References and Notes

1. Molybdenum and potassium contents were determined by means of a Jarrell-Ash 1.5-meter direct-reading emission spectrograph, the 4044-Å line being used for potassium and the 2816.2-Å line in the second order for molybdenum.
2. M. W. Borys and N. F. Childers, *The Role of Molybdenum in Plants and Soils* (Horticulture Department, Rutgers Univ., New Brunswick, N.J., 1960).
3. R. C. Rossiter, *Australian J. Agr. Res.* 3, 244. (1952).

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Electron Spin Resonance Characteristics of Some Normal Tissues: Effect of Microwave Power

Abstract. Electron spin resonance measurements of normal tissue at 77°K indicate the presence of two types of resonances which can be identified by varying the incident microwave power: (i) an intense, easily saturable, organic free-radical component and (ii) a weak but relatively nonsaturating component probably due to paramagnetic trace elements.

Studies on electron spin resonance (ESR) signals in normal tissue do not always appear to yield the same result. Commoner and Ternberg (1) and Kerkut *et al.* (2) find that most tissues have a relatively simple ESR spectrum consisting of a symmetrical resonance centered at $g = 2$ (g is proportional to energy/magnetic field) occurring both at physiological (273°K to 323°K) (1) and at low temperatures (77°K) (1, 2). Nebert and Mason (3), on the other hand, find a much more complex ESR spectrum in normal liver and cardiac muscle at low temperatures (110°K), including prominent peaks some distance from $g = 2$. Our examinations of normal tissue at 77°K indicate that both types of observations are correct and that the apparent conflict is due to variance in the modes of operation of the electron spin resonance spectrometers.

The ESR spectra of normal tissue (Fig. 1) were obtained from a mongrel dog by laparotomy; the tissue was placed into glass tubes, frozen quickly in liquid nitrogen, and then removed from the tubes in the form of frozen

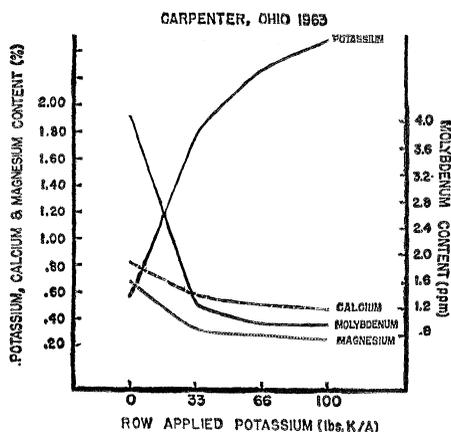


Fig. 1. Changes in the calcium, magnesium, molybdenum, and potassium content of corn leaves after fertilization of the plants with different amounts of potassium (expressed as pounds of potassium per acre; 1 lb/acre is equivalent to 1.12 kg/hectare).