CC/NUMBER 7
FEBRUARY 18, 1985

This Week's Citation Classic™

Bukovac M J & Wittwer S H. Absorption and mobility of foliar applied nutrients. *Plant Physiol.* 32:428-35, 1957.
[Department of Horticulture, Michigan State University, East Lansing, MI]

In this paper, we described the absorption and mobility of inorganic nutrient ions following their application to leaves of *Phaseolus vulgaris* L. The time-course of absorption was determined, and the ions were classified as to mobility based on degree of export from the absorbing leaf. [The *SCI*® indicates that this paper has been cited in over 130 publications since 1957.]

M.J. Bukovac
Department of Horticulture
College of Agriculture
and Natural Resources
Michigan State University
East Lansing, MI 48824-1112

January 9, 1984

My interest in foliar absorption of nutrients stemmed from my contacts with H.B. Tukey and S.H. Wittwer during my graduate studies at Michigan State University. I recall numerous lively discussions at professional meetings on the relative merits of foliar *vs.* soil nutrition and, in particular, on the mobility of nutrient ions in the plant following absorption by the leaf. Most of these discussions were based on indirect evidence and seldom led to firm conclusions. It appeared to me that with the increasing availability of radioisotopes, it should be straightforward to answer conclusively many of the questions being argued.

Upon completion of my graduate studies, I had the good fortune of being offered a postdoctoral appointment by Wittwer, who at that time was deeply involved in studies on foliar uptake of nutrients. Using the common bean, we established foliar penetration curves for many of the essential plant nutrients and, based on degree of export from the absorbing leaf, assigned to each a mobility index. All of the essential nutrient elements were readily absorbed by the foliage and transported, but not at equal rates or in a comparable pattern.

Sodium, rubidium, and potassium were the most readily absorbed and highly mobile. Calcium, magnesium, and strontium, while absorbed by the leaf, were not exported and were considered immobile. Foliar absorption of phosphorus, chlorine, sulfur, zinc, copper, manganese, iron, and molybdenum was intermediate, with mobility decreasing in the order given. Our data on distribution patterns nicely confirmed earlier conclusions on relative mobility based upon which tissues first exhibited deficiency symptoms.

Our approach was simple and provided conclusive data. Perhaps the greatest problem we had during these studies was the delay in delivery of short-lived isotopes, winter flying weather being our worst enemy.

On completion of my postdoctorate, my research emphasis changed to plant growth regulation. However, I remained keenly interested in foliar absorption and, as part of this program, continued studies on the structure of the cuticle and its permeability to plant growth regulators.[1,2]

I suspect that the reasons for the frequent citation of this paper are: first, publication in *Plant Physiology* provided wide exposure to the scientific community; second, this was probably the first exhaustive attempt to assess directly in a single test system the mobility of the major and minor essential plant nutrients; and, third, the logistical difficulties, at that time, in working with short-lived isotopes may have discouraged many from undertaking similar experiments.

Publication of this paper was fortuitous for me for two reasons: it brought me in contact with many leading scientists, and it eventually led to an invitation to work in England with G.E. Blackman, who headed the Agricultural Research Council Unit at Oxford University.

1. **Bukovac M J.** Herbicide entry into plants. (Audus L J. ed.) *Herbicides: physiology, biochemistry, ecology.* New York: Academic Press. 1976. p. 335-64.
2. **Bukovac M J, Rasmussen H P & Shull V E.** The cuticle: surface structure and function. *Scanning Electron Microscopy* **1981**(Pt. 3):213-23.

