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Fate of calcium crystals in alfalfa fed to cattle

Abstract

Calcium crystals were located in parallel rows surrounding vascular bundles in alfalfa leaves and under the epidermis of alfalfa stems. The crystals remain intact on vascular bundles in the rumen. Most crystals are dislodged in fecal matter, and free crystals can be recovered. These data support previous work here showing that calcium from alfalfa may be less available to ruminants than previously thought.

Keywords

Cattlemen's Day, 1978; Report of progress (Kansas State University. Agricultural Experiment Station); 320; Beef; Calcium crystals; Alfalfa

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Fate of Calcium Crystals in Alfalfa Fed to Cattle

L. H. Harbers and G. M. Ward

Summary

Calcium crystals were located in parallel rows surrounding vascular bundles in alfalfa leaves and under the epidermis of alfalfa stems. The crystals remain intact on vascular bundles in the rumen. Most crystals are dislodged in fecal matter, and free crystals can be recovered. These data support previous work here showing that calcium from alfalfa may be less available to ruminants than previously thought.

Introduction

We used a scanning electron microscope equipped with an energy dispersive X-ray analyzer to define and identify crystals surrounding vascular bundles of various legumes. Studies by biologists, entomologists, and geologists at Kansas State University made the identifications. Earlier studies here indicated that calcium in alfalfa was less available than previously believed. We used the microscope to confirm presence of the crystals in alfalfa and to study their fate in ruminants.

Methods

Alfalfa-leaf residues were obtained from rumen and feces of fistulated steers maintained on a diet of alfalfa hay and salt. We isolated vascular tissue and crystalline material by dilution and centrifugation, then air-dried, mounted, and coated samples with carbon. Using a scanning electron microscope, we made secondary photographs and elemental dispersion maps.

Results and Discussion

A photograph of a vascular bundle from an alfalfa leaflet (figure 1.1 a) shows crystals intact in the bundle sheath cells. The crystals are primarily calcium as shown in the corresponding calcium-dot map (figure 1.1 b). The calcium crystals remain intact in the rumen.

Many crystals are removed from the vascular bundle sheaths by the time the material passes in feces (figure 1.1c). Crystals of the same type or shape (figures 1.1d, e) can be recovered from the feces, where some appear to be digested to various degrees, but extracting intact crystals suggests that many pass through the gastrointestinal tract undisturbed by mechanical, chemical, or enzymatic digestion.

If so, the calcium from alfalfa is less available than previously thought. Other work indicated that the calcium is about 60% as available as calcium from inorganic sources.

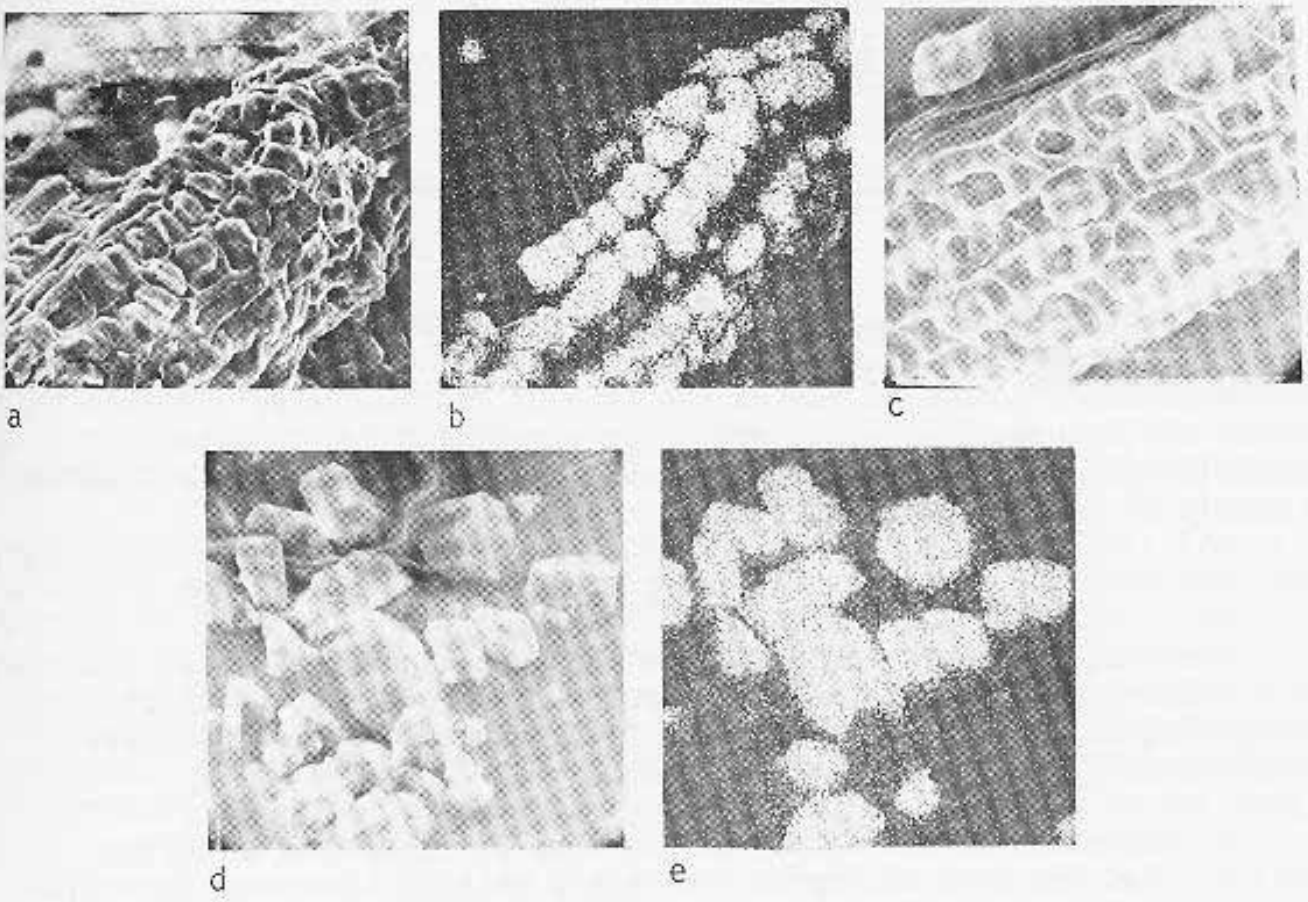

Figure 1.1. Photomicrographs of calcium crystals in alfalfa. a) Vascular bundle from alfalfa leaflet shows crystals surround the bundle that remains intact in the rumen (700X). b) A concentration map of the bundle shows the crystals are composed of calcium. c) A vascular bundle isolated from feces indicates that some crystalline material was removed after passing from the rumen (1200X). d) Crystals recovered from the feces of a steer fed alfalfa resemble those on vascular bundles (1500X). e) An X-ray dispersion map shows that the crystals are calcium.