

Wright M J & Davison K L. Nitrate accumulation in crops and nitrate poisoning in animals. *Advan. Agron.* 16:197-247, 1964.  
[Cornell University, Ithaca, NY]

Circumstances of nitrate accumulation in plants and its potential hazard to man and animals were reviewed. Cattle and sheep can grow, gestate, and lactate normally despite chronic and, in some cases, even severe methemoglobinemia induced by ingesting nitrate. Adaptation to methemoglobinemia occurred. [The SCI® indicates that this paper has been cited in over 140 publications since 1964.]

Madison J. Wright  
Department of Agronomy  
Cornell University  
Ithaca, NY 14853  
and  
Kenneth L. Davison  
Metabolism & Radiation Research  
Laboratory, ARS, USDA  
North Dakota State University  
Fargo, ND 58105

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"The early-1960s were years of intense interest in nitrate, both among plant and animal scientists, and among agricultural producers. Crop physiologists were testing the idea that nitrate reductase was the rate-limiter in protein formation and growth. The cost of nitrogen fertilizer was dropping rapidly, encouraging new and heavier applications to crops known to accumulate nitrate. Outbreaks of silo gas (oxides of nitrogen) poisoning of humans, and acute nitrate poisoning (methemoglobinemia) of ruminants signaled dangers, and a widespread drought in the Midwest not only accentuated these acute problems but also led diagnosticians to attribute a variety of other troubles to 'chronic nitrate toxicity.'

"A fortuitous association of agronomists, animal physiologists, and veterinary pathologists at Cornell University formed the basis for a grant from the National Institutes of Health (NIH) to examine 'chronic nitrate toxicity' on an unprecedented scale. Crawford and Kennedy<sup>1</sup> had already extended

their agronomic research to administering nitrate to dairy cows when Wright arrived from Wisconsin where nitrate had been indicted as the cause of abortion in cattle grazing weedy pastures.<sup>2</sup> Hansel agreed to oversee the systematic administration of nitrate to dairy cattle. McEntee and Krook agreed to conduct histological examinations on the cattle so treated. Davison assumed full-time duties as animal physiologist.

"When Crawford attempted to publish his findings, a reviewer returned the manuscript with a dissertation explaining 'nitrate poisoning' to him. (Another journal accepted Crawford's paper.) Four years later, acute toxicity had been better defined than ever before, but the existence of 'chronic toxicity' had been largely discounted.<sup>3</sup> Animals driven to and beyond the brink of collapse by daily heavy doses of dietary nitrate freshened and produced milk in an essentially normal fashion. Their milk contained almost negligible amounts of nitrate and their tissues bore no lesions that were diagnostically useful. It was a setback for field diagnosticians, since the serious production problems that had been attributed to minor or moderate concentrations of nitrate in water or feed reverted to the status of undiagnosed.

"Meanwhile, the rapid rebound in the cost of nitrogen fertilizer has reduced the frequency of excessive applications to crops. Some of the recorded disasters, however, occurred where no fertilizer was applied so the agricultural problems have not been permanently prevented, even if they are better understood now.

"W.H. Allaway, then director of the USDA Plant, Soil, and Nutrition Laboratory on the Cornell campus, encouraged us to prepare the review. We believe that its popularity as a reference is due to the exhaustiveness of the experimentation it presented to scientists and practitioners who had been perplexed by reports from the field, and to the way it brought together accounts of the transformations of biologically active nitrogen in air, water, soil, crop plants, weeds, domestic animals, and humans."

1. Crawford R F, Kennedy W K & Wright M J. Nitrate in forage crops and silage: benefits, hazards, precautions. Ithaca, NY: New York State College of Agriculture, [Cornell University, 1966. 12 p. Cornell Miscellaneous Bulletin 37.
2. Sand J M, Wright M J & Simon J. Weeds containing nitrates cause abortion in cattle. *Agronomy J.* 49:278-9, 1957.
3. Davison K L, Hansel W, Krook L, McEntee K & Wright M J. Nitrate toxicity in dairy heifers. I. Effects on reproduction, growth, lactation, and vitamin A nutrition. *J. Dairy Sci.* 47:1065-73, 1964.