

This Week's Citation Classic

Hewitt E J. Assimilatory nitrate-nitrite reduction. *Annu. Rev. Plant Physiol.* **26**:73-100, 1975. [Long Ashton Research Station, Univ. Bristol, Long Ashton, Bristol, England]

Eukaryotic nitrate reductases contain cytochrome *b*, FAD, and molybdenum in a labile cofactor where tungsten competes. Apoprotein is an inducible single gene product with dehydrogenase activity. Holoenzyme activity shows complex regulation. Nitrite reductases have sirohaem and non-haem iron, labile sulphur centres, and transfer six electrons without liberating intermediate products. [The SC[®] indicates that this paper has been cited over 120 times since 1975.]

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"I came to Long Ashton in November 1942 following an enigmatic telephone message and an unsanctioned interview arranged between shifts at a TNT factory. I moved with few regrets to assist (the late) T. Wallace, CBE, FRS, in diagnosing nutritional disorders in crops growing especially on marginal lands during the national ploughing-up campaign. I was told to produce effects of all possible nutritional disorders in any chosen crop using sand culture on an unprecedented scale. Being young, inexperienced, and unaware that my senior predecessor had departed at the prospect, I saw no problems. I received two simple orders. 'You have no hours —just do the job'; 'Do something —and something will happen.' I began by sweeping leaves out of a large, earth-floored greenhouse and dipping heavy clay pots into molten paraffin wax over a coal fire. I then tried forcing pressurised steam from a hand-hose into sand and boiling acid in a cider barrel. Before the eroded drains were discovered, I had devised a safer engineering process. The Long Ashton methods and nutritional technology were described in a commissioned

monograph¹ and I owe much in these early years to the critical and kindly guidance of D. Akenhead, OBE, and G.K. Argles, directors of the sponsoring bureau.

"The most exciting early result was the first experimental reproduction of 'whiptail' in cauliflowers grown in molybdenum deficient sand cultures using a new method for nutrient purification.² Continued work on 'whiptail,' studying effects of nitrogen sources with S.C. Agarwala and induction of nitrate reductase with M.M.R.K. Afridi, established my joint interests in inorganic nitrogen metabolism and micronutrients. Isolation of the tungsten analogue of nitrate reductase with B.A. Notton provided the *rationale* for current uses of tungsten and helped towards further understanding of 'whiptail.'³ Confusion resulting from trying to use reduced benzyl viologen with nitrate reductase caused some contention until we realised with excitement, we had found nitrite reductase in a new measurable system which led to revision of some previous notions.⁴

"Now well-defined projects with clearer, if distant, objectives have evolved from our random flights of fancy, and more agronomically relevant species, which not surprisingly seem prone to new experimental difficulties, concentrate our minds. Such constraints coincide with respectability and recognition of future promise. Moreover the pursuit of useful knowledge needed to achieve physiological regulation and genetic modification must take account of the probable individuality of crop species.

"Perhaps my review was cited because I tried to present a fundamental and comparative survey of a complex topic which is interesting to many scientists in different ways, and in which research activity has been expanding rapidly. It was therefore timely in the judgement of the editors of the *Annual Review of Plant Physiology*. The traditionally high standards of other invited contributions probably encouraged some confidence in reading what I had hoped would be a critical and informative communication supported by extensive experience. A-a-V"

1. Hewitt E J. *Sand and water culture methods used in the study of plant nutrition*. East Mailing, Maidstone, Kent, England: Commonwealth Bureau of Horticulture and Plantation Crops, 1952. Technical communication no. 22.
2. Hewitt E J & Jones E W. The production of molybdenum deficiency in plants in sand culture with special reference to tomato and brassica crops. *J. PomoL. Hon. Sci.* **23**:254-62, 1947.
3. Fido R J, Gundry C S, Notton B A & Hewitt E J. Ultrastructural features of molybdenum deficiency and "whiptail" of cauliflower leaves: effects of nitrogen source and tungsten substitution for molybdenum. *Aust. J. Plant Physiol.* **4**:675-89, 1977.
4. Hageman R H, Cresswell C F & Hewitt E J. Reduction of nitrate, nitrite and hydroxylamine to ammonia by enzymes extracted from higher plants. *Nature* **193**:247-50, 1962.