

reversed by a 100 times equimolar concentration of L-leucine.

The effects of ANCPA on mitosis in pea-root tips, on the other hand, can be reversed by very low concentrations of L-leucine. The effect is apparently not competitive (Table 3).

Table 3. NUMBER OF MITOTIC FIGURES PER 1,000 NUCLEI IN PEA ROOT TIPS (24 h after treatment with ANCPA)

ANCPA ($\times 10^{-5}$ M)	Exp. 1 L-Leucine ($\times 10^{-5}$ M)		Exp. 2 L-Leucine ($\times 10^{-5}$ M)				
	0	7.6	0	1.5	3.0	6.0	30.0
0	92	100	118	—	—	—	—
0.06	14	90	—	—	—	—	—
0.6	0	83	—	—	—	—	—
3.0	0	121	0	18	77	92	—
30.0	—	—	0	—	—	126	155

Thus, in some experimental systems at least, ANCPA is a well-defined leucine antagonist. In this connexion its effect on *Nicotiana* plants is interesting. Doses of 10 μ g/plant injected into the apical buds of young rosette-stage plants delayed stem formation and induced production of narrow, strap-like leaves with pronounced interveinal chlorosis, with increased development of lateral shoots. This closely simulates the physiological condition known as frenching⁴, which can also be simulated by feeding seedlings with isoleucine or *alloisoleucine*⁵. A number of synthetic analogues of ANCPA, including 1-aminocyclopentane-1-carboxylic acid and 1-aminocyclohexane-1-carboxylic acid, have also recently been shown to be amino-acid antagonists⁶⁻⁸.

It is not possible at present to characterize the effects of ANCPA on plant metabolism more closely, but it is noteworthy that 2-thiouracil induces comparable morphogenetic changes in *Cannabis*⁹ and that this has been interpreted¹⁰ as an inhibition of protein synthesis due to a disturbance of RNA metabolism.

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Cation-anion Ratios of Plants

DIJKSHOORN¹ has recently summarized the results of many analyses for the total equivalents of metals (potassium, sodium, magnesium, calcium) and non-metals (nitrogen, phosphorus, sulphur, chlorine) in *Lolium perenne*, and has calculated the balance of acidity within the plant following on the higher intake of non-metals as anions. From the content (in equiv./kg) of metals as 1.8 and non-metals as 3.2 he concludes that internal acidity must have risen by 1.4, but that this is more than offset by the reduction of nitrate and sulphate, both of which consume acid. If the reduction of nitrate is written as $\text{HNO}_3 + 8\text{H} \rightarrow 3\text{H}_2\text{O} + \text{NH}_3$, one obtains a disappearance of 1 or 2 protons per nitrogen reduced, according to whether one treats NH_3 as a neutral molecule (as Dijkshoorn does) or as an alkali.

This calculation suggests a comparison with the effect on internal acidity of absorbing ammonium ion from solution. For every atom of nitrogen absorbed as NH_4^+ , one proton disappears from the plant; for every atom absorbed as NO_3^- one proton appears in the plant, but the reduction of this ion to ammonium absorbs two protons, so that the net internal effect so far is the same for both forms of nitrogen. However, when the intake of other nutrients is considered, the two forms affect the internal acidity differently. Both these ions in glasshouse cultures are absorbed more rapidly than any others, so that NH_4^+ cultures become acid and NO_3^- cultures become alkaline. But if we calculate the non-nitrogenous ions from such results as those of Coic *et al.*², we find that there remains a net excess absorption of cations in both cases, but far stronger for NO_3^- than for NH_4^+ cultures (Table 1). Thus the nitrate plants consume a greater net total of internal acidity than do the ammonium plants.

Table 1. CONTENT OF MAJOR NUTRIENTS IN PLANTS GROWN IN CULTURE SOLUTION

	(Coic <i>et al.</i>) (m.equiv./100 g fresh weight)	
	Nitrate cultures	Ammonium cultures
Maize	Nitrogen as anion	45.0
	P, S, Cl	11.9
	Nitrogen as cation	—
	K, Ca, Mg	24.5
	Excess non-N cation	12.6
Tomato (young leaves)	Nitrogen as anion	55.1
	P, S, Cl	11.2
	Nitrogen as cation	—
	K, Ca, Mg	40.0
	Excess non-N cation	28.8

One may use these results also in considering the doctrine of a constant ratio of metals to non-metals in plants³. This has been dealt with by Cunningham⁴, who pointed out that the ratio of metals to non-metals in Italian rye-grass in Britain ranged from 0.33 to 0.93. If the foregoing doctrine rests on the idea that plants absorb cations at about half the rate of anions, then it is opposed by the work just quoted² where plants in ammonium cultures absorb cations four times as rapidly as anions. In Cunningham's plants grown with heavy doses of ammonium sulphate, the ratio of metal to non-metal (unfortunately quoted by him as cation-anion ratio) was the lowest of all at 0.33; but the true cation-anion ratio may have been the highest of all since much ammonium was probably absorbed as such. As a further point against the belief in a constant ratio, anion uptake has a higher temperature coefficient than cation uptake⁵ and Cunningham's value of 0.93 for winter fits this last-mentioned relation.

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Genesis of Ethylene in Apples

EVER since Kidd and West¹ showed that emanations from ripe apples stimulated unripe apples into the respiration climacteric, and Gane² proved that the active principle in these emanations was ethylene, search has been made for the origin of this 'ripening hormone'. The search has been intensified in the past few years. Burg and Thimann³ state that "there is general agreement that ethylene production is restricted to the stage in the life of fruits during which ripening occurs". They were unable to decide precisely the source of the ethylene, but suggested that it may be produced by the mitochondria. Later Burg⁴ concluded that the biosynthetic source of ethylene is not to be found in intermediates of glycolysis, acid metabolism