PHYSIOLOGICAL AND BIOCHEMICAL ADAPTATION IN THE NITROGEN NUTRITION OF *SPIRODELA OLIGORRHIZA*

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February, 1969

Thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy of the University of Auckland.

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ABBREVIATIONS AND NOMENCLATURE

The abbreviations used in this thesis are based on the revised tentative rules (1965) recommended by the IUPAC-IUB Combined Commission of Biochemical Nomenclature for chemical names of special interest in biological chemistry (*Biochem.* 5 (1965): 1445-1453 and subsequently). The following abbreviations not listed by the commission were also used:

EDTA	ethylenediaminetetraacetic acid
PVP	polyvinylpyrrolidon

In some literature citations, the forms DPN and TPN are used instead of the recommended abbreviations, NAD and NADP.

The term "ammonium" is used without implying whether free ammonium ions or undissociated ammonium compounds (e.g. ammonium hydroxide) are actually present.

The term "nitrate" is taken as meaning nitrate ions.

All amino acids are, unless otherwise stated, the *L*-isomers.

ACKNOWLEDGEMENTS

I would like to thank the following people:

Mr. J. D. Atkinson, Director, Fruit Research Division, Department of Scientific and Industrial Research, for allowing me to carry out this work while a member of his staff.

Professor R.E.F. Matthews, Department of Cell Biology.

My supervisor, Dr. E.G. Bollard, Fruit Research Division, for his advice and encouragement, and for his detailed criticism of the manuscript.

Dr. R.L. Bieleski, Fruit Research Division, for his advice on the planning of some of the experiments described in Section 6, and for reading Section 4.

Mr. N.A. Turner, Fruit Research Division, for advice on experimental techniques, and for reading Section 3.

Mr. A. Underhill, Plant Diseases Division, who took the photographs.

Mrs. P. Bond, who xeroxed the graphs.

Miss J. Irwin, who typed the manuscript.

SUMMARY

1. A study was made of some aspects of the utilization by *Spirodela oligorrhiza* of ammonium, nitrate, nitrite, and organic nitrogenous compounds as sole sources of nitrogen.

2. *S. oligorrhiza* was grown in axenic culture under carefully defined conditions, and the only factors to be consciously varied were those relating to the nitrogen source.

3. Ammonium, or some product of its assimilation, inhibited the utilization of nitrate by inhibiting, at least partially, the uptake of nitrate, and by inhibiting almost completely the reduction of nitrate to nitrite.

4. Nitrite also inhibited the utilization of nitrate.

5. Ammonium and nitrite were taken up and assimilated simultaneously when they were supplied together in the medium.

6. Nitrate reductase and nitrite reductase were found to be adaptive enzymes, being present in *S. oligorrhiza* only when it was supplied with nitrate or nitrite. There was good correlation between the concentration of nitrate in plants and the levels of nitrate reductase that they contained.

7. When plants not containing nitrate and nitrite reductases were supplied with nitrate, there was a rapid increase in the levels of both enzymes and in the concentration of nitrate in the plants. This increase was retarded but not prevented by ammonium.

8. When nitrate-grown plants were depleted of nitrogen, there was a rapid decrease in the levels of nitrate and nitrite reductases. This was a real loss of enzyme activity, and not simply dilution by growth.

9. The utilization of ammonium prevented the assimilation of nitrate even by plants that contained high levels of nitrate and nitrite reductases. It was therefore concluded that ammonium, or the processes or products of its assimilation, must inhibit the activity of nitrate reductase.

10. Plants utilizing ammonium contained higher levels of ammonium, arginine, asparagine, and glutamine than did those utilizing nitrate. The concentrations of all other amino acids were very similar.

11. None of these compounds, tested either separately or together, had any effect on the activity *in vitro* of nitrate reductase. Cyanate was an inhibitor of nitrate reductase, but it is not known whether this inhibition has any physiological significance.

12. *S. oligorrhiza* can use asparagine and glutamine as sole sources of nitrogen. These compounds were taken up as such and did not undergo any prior amidohydrolysis in the medium.

13. Plants supplied with any two of a number of organic nitrogenous compounds, each capable by itself of serving as a sole source of nitrogen, usually took both up from the medium, although at different rates. Thus glutamine was taken up more rapidly than was glutamic acid when they were supplied together in the medium.

14. Ammonium was taken up more rapidly than glutamic acid when they were supplied together in the medium. Similarly, ammonium was taken up more rapidly than aspartic acid.

15. Asparagine, *D*-glutamine, and glutamic acid did not inhibit the rate of uptake of glutamine as measured over short periods.

16. Asparagine, aspartic acid, and *L*-glutamine strongly inhibited the rate of uptake of glutamic acid, but *D*-glutamine and ammonium had no effect.