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Edited by C. SYBESMA

ADVANCES IN AGRICULTURAL BIOTECHNOLOGY

The majority of the invited contributions are review papers, summarizing and putting into perspective the latest results of research in a particular area; the other contributions comprise research papers giving details on specific aspects. "Advances in Photosynthesis Research", therefore, is an important document, containing the latest high-level information about photosynthesis in its broadest sense. The four volumes are of considerable value as a reference source for scientists active in the field and others wishing to be informed about recent developments. Furthermore, these volumes will prove to be important as a means of background study for those entering this exciting and promising field of investigation.

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Photosynthesis Research aims to provide a forum for original papers dealing with photosynthesis without imposing an artificial division between fundamental and applied research. Our aim is to cover *all aspects of photosynthesis research* starting from the primary reactions and going as far as the energy from biomass. Topics acceptable for publication could include primary reactions, electron transport, photophosphorylation, carbon assimilation, regulatory phenomena, environmental and ecological aspects of photosynthesis, photorespiration, CO₂ fixation in CAM plants, and bacterial and algal photosynthesis, although one should not feel restricted just to these topics.

In the case of artificial systems, the authors should be able to judge for themselves whether to publish in a photosynthesis or photobiology journal. In the case of doubt, the Editorial Board can help the author in making this decision.

Papers will be considered for publication at all levels of plant organization: sub-cellular, cellular, whole plant and canopy levels.

Manuscripts submitted for publication are always reviewed by two referees, not necessarily members of the Editorial Board, and chosen for their competence in the field covered by the paper. The appeal to people who are not members of the Editorial Board is necessary in order to cover the whole field of photosynthesis.

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Available at the end of 1984

Photosynthesis During Leaf Development

Edited by
Z. SESTAK

This unique monograph was written by nine scientists from the Department of Physiology of Photosynthesis and Water Relations of the Institute of Experimental Botany, Czechoslovak Academy of Sciences in Prague. They based it on a choice of papers from the vast literature, which was not always easy to assess, and on the 20 years pioneering research experiences of their laboratories.

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^1H NMR SPECTROSCOPY OF PROTOCHLOROPHYLLIDE Mg. PHOTOREDUCTION OF PROTOCHLOROPHYLLIDE Mg AND PROTOCHLOROPHYLLIDE Zn IN ETIOPLAST LAMELLAE.

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Photobiology Laboratory, B22, and ** Laboratory of Physical Organic Chemistry, B6, University of Liège, B4000, LIEGE (Belgium).

* Research Associate at the 'Fonds National de la Recherche Scientifique Belge'.

1. INTRODUCTION

The accurate chemical structure of the precursor of chlorophyll, protochlorophyllide which has been accumulated in etiolated primary bean leaves has not yet been completely assessed*, especially with respect to the occurrence of an ester group (phytol, methyl ...) at the propionic chain, or of a second vinyl at carbon C_4 . As absorption and fluorescence spectroscopy is unable to solve this question we have recorded the high resolution (360 MHz) ^1HMR spectra of the purified pigment extracted from etiolated bean leaves. For valuable comparison, the esterified pigment (protochlorophyll = PChl) from the pumpkin cuticle has been extracted and purified. This pigment is esterified by a long-chain alcohol.

Mg^{2+} has been substituted by Zn^{2+} in purified protochlorophyllide in view to compare in a first approach the physico-chemical properties of PChlide Mg and PChlide Zn, and to understand the role of the central ion. These pigments were further linked to the apoprotein (protochlorophyllide photoreductase) present in the etioplast lamellae.

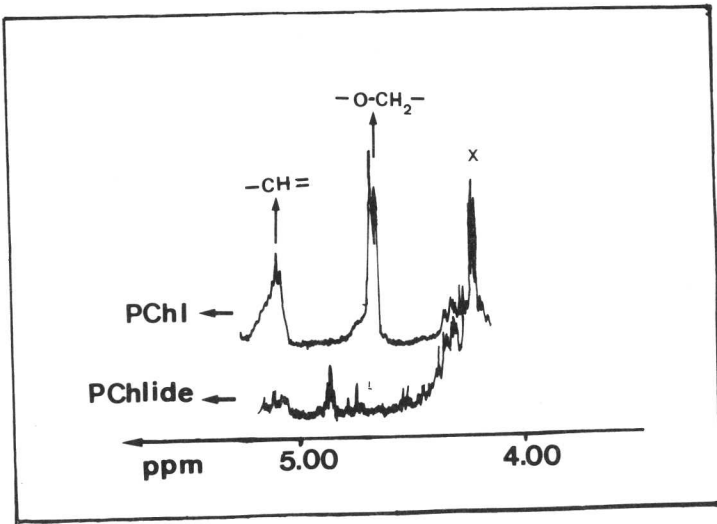


Figure 1. ^1H NMR spectra of PChlide and PChl showing that in PChl the $-\text{O}-\text{CH}_2-$ and the $-\text{CH}=\text{}$ of a long-chain alcohol is present.

* Protochlorophyllide (abbrev.: PChlide) has currently been considered as the free acid of 2-vinylpheoporphyrin $\text{a}_5\text{-Mg}$.

Sybesma, C. (ed.), *Advances in Photosynthesis Research*, Vol. IV. ISBN 90-247-2945-9.

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2. MATERIAL AND METHODS

This will be published elsewhere (Bombart, Dujardin, 1984).

3. RESULTS

3.1. Characteristical regions of the ^1H NMR spectra.

The high resolution ^1H NMR spectra of protochlorophyllide are presented in figs. 1 and 2. Fig. 1 shows the lack of the $-\text{O}-\text{CH}_2-$ doublet resonance of a long-chain alcohol, when compared to the same region in the ^1H NMR spectrum of protochlorophyll (Rasquain et al., 1977; Katz et al., 1963).

Fig. 2 shows the resonance of a $-\text{CH}_2$ (4), $-\text{CH}_3$ (4') at the level of carbon C_4 which is characteristic of an ethyl substituent and not a vinyl (which is present in divinylprotochlorophyll(ide)).

3.2. The PChlide Zn in etio-
plast lamellae.

Protochlorophyllide Mg and Zn have very similar absorption and fluorescence spectra. The red absorption and fluorescence maxima of protochlorophyllide Zn are shifted towards shorter wavelengths by only a few nanometers from those of PChlide Mg.

It was therefore expected that PChlide Zn should behave in a similar way as PChlide Mg, when introduced in the presence of NADPH, into a suspension of etioplast lamellae, which have been previously depleted from photoreducible PChlide Mg by illumination. Griffiths (1980) has shown that the exogenous PChlide Mg is able to form a complex with the apoprotein and the cofactor; when illuminated, this complex is photoreduced to Chlide Mg. We have established that when exogenous PChlide Mg and PChlide Zn are introduced with NADPH in PChlide depleted etioplast lamellae, both form two distinct photoreducible complexes with the aporeductase. Figure 3 A and figure 3 B present the corresponding absorption and fluorescence spectra for the newly formed PChlide Mg and Zn. The zinc photoreducible complexes absorb at 637 and 645 nm and they emit a fluorescence at 640 and 652 nm. The Mg photoactive complexes absorb at longer wavelengths than the zinc comple-

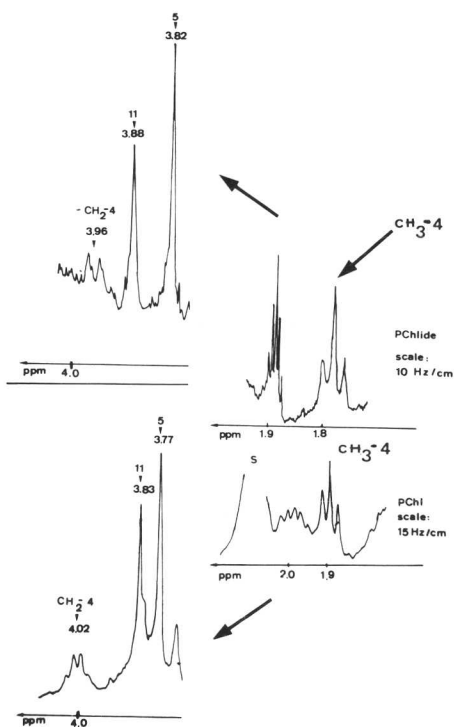


Figure 2. ^1H NMR spectra of PChlide and PChl showing that these pigments have a $-\text{CH}_2-\text{CH}_3$ in C_4 position.

xes, namely at 640 and 650 nm, they emit their fluorescence at 655 nm. We have demonstrated that all the photoreducible PChlide Mg and protochlorophyllide Zn complexes are converted into chlorophyllide Mg or chlorophyllide Zn after flash illumination. Further experiments have also proved that the pigment obtained by photoconversion of the protochlorophyllide Zn-protein complexes is surely chlorophyllide Zn. Complete data will be published elsewhere (Bombart, Dujardin, 1984).

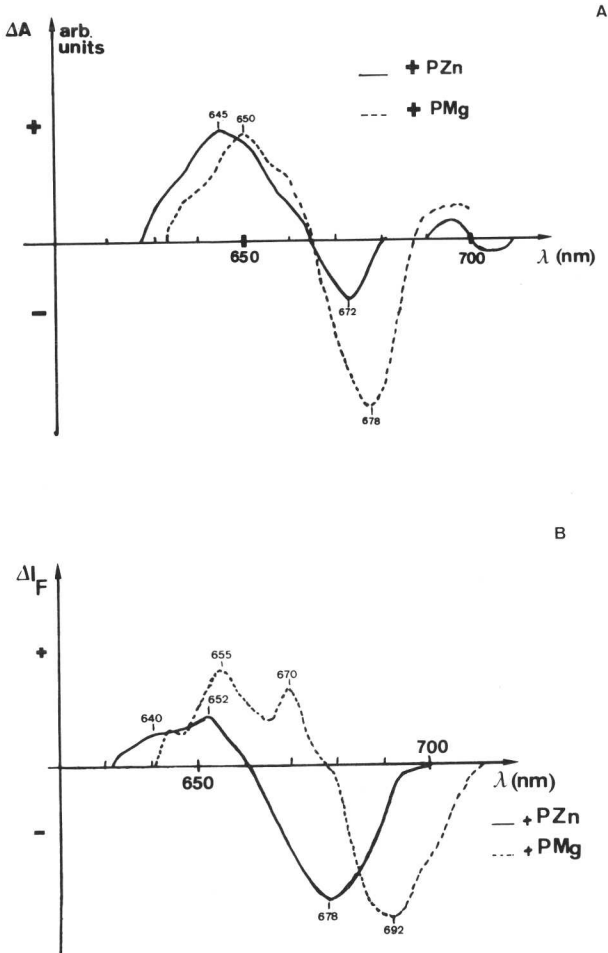


Figure 3. Difference absorption (A) or fluorescence (B) spectra (77 K) between an etioplast suspension incubated with PChlide Zn and the same suspension after flash illumination (full line); dashed line : same spectra but with PChlide Mg (+ PMg).

4. REFERENCES

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5. ACKNOWLEDGEMENTS

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Edited by

Z. SESTAK and J. CATSKY

Institute of Experimental Botany, Czechoslovak Academy of Sciences, Prague

The Photosynthesis Bibliography includes papers in all fields of photosynthesis research which have appeared in the most important scientific periodicals and books in the respective years.

- Vol. 1, 1966/1970: References 1-9087/AAS-ZWE. 1974, xii, 599 pp.
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Protochlorophyllide Reduction and Greening

Proceedings of a meeting held at the University of Liège, 8-9 August 1983.

Edited by **C. SIRONVAL** and **M. BROUERS**

ADVANCES IN AGRICULTURAL BIOTECHNOLOGY

1984. 408 pp. Dfl. 145.00/US\$ 55.00/£ 37.00

ISBN 90-247-2954-8

In this new book, the recent advances in the field of protochlorophyllide reduction and greening are discussed. These advances deal with: 1) The characterization of the basic constituents of the protoenzymatic complex responsible for protochlorophyllide reduction. 2) The discovery of short-lived intermediates in the photoreduction process and in particular, the recent findings resulting from the progress of the picosecond and nanosecond spectrometry. 3) The obtention of new data on the components of the plastids, on the change they undergo during the first steps of greening and on the distribution of the pigment protein complexes between the various substructures of the etioplast. 4) The detection of early photoactivities apart from protochlorophyllide reduction.

In particular, researchers in photosynthesis, photobiology, biophysics, plant physiology and biochemistry, will derive much value from this publication.

Effects of Stress on Photosynthesis

edited by **R. MARCELLE**, **H. CLIJSTERS** and **M. Van POUCKE**

ADVANCES IN AGRICULTURAL BIOTECHNOLOGY

1983, x, 388 pp., Dfl. 120.00/£ 30.50/US\$ 52.00

ISBN 90-247-2799-5

The aim of the third photosynthesis meeting, which was organised jointly by the research station of Gorseem and the Limburgs Universitair Centrum, was to bring together current research findings on the effects of various stress factors on photosynthesis. The effects of low and high temperatures, water stress and water logging, dull and bright light, root anoxia, salinity and heavy metals, on photosynthesis, are examined in the chapters of this book.

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