

CONTENTS

I. INTRODUCTION

Prefatory Chapter: Enhancing Biological Production of Ammonia From Atmospheric Nitrogen and Soil Nitrate	3
A. Hollaender	
Support of Problem Focused Nitrogen Fixation Research at the National Science Foundation	7
H. T. Huang	
Biological Nitrogen Fixation Research at the University of California, Davis	11
C. E. Hess	

II. GENETICS AND REGULATION OF NITROGEN FIXATION

A. Molecular Cloning of Nitrogen Fixation Genes

Molecular Cloning of Nitrogen Fixation Genes from <u>Rhizobium meliloti</u>	15
F. M. Ausubel and G. B. Ruvkun	
Cloning DNA from <u>Rhizobium meliloti</u> Using a New Broad Host Range, Binary Vehicle System . . .	31
G. Ditta, S. Stanfield, D. Corbin, and D. R. Helinski	
Molecular Cloning of <u>Rhizobium japonicum</u> DNA in <u>E. coli</u> and Identification of Nitrogen Fixation (Nif) Genes	41
H. Hennecke and J. R. Mielenz	

B. Genetics and Regulation of Nitrogen Fixation Genes

The Identification, Location and Manipulation of Genes in <u>Rhizobium</u>	55
J. E. Beringer	

The Role of <u>Rhizobium</u> Plasmids in Host Specificity	65
N. J. Brewin, J. L. Beynon, and A. W. B. Johnston	
"Redox Control" of Nitrogen Fixation: An Overview	79
K. T. Shanmugam, S. T. Lim, S. S. M. Hom, D. B. Scott, and H. Hennecke	
A Mutant of <u>Rhizobium japonicum</u> 110 with Elevated <u>Nif</u> Activity in Free-Living Culture . . .	95
S.-S. T. Hua, D. B. Scott, and S. T. Lim	
C. Hydrogen Uptake and Energetics	
Detrimental and Beneficial Effects of Oxygen Exerted on Hydrogen-Oxidizing Bacteria	107
H. G. Schlegel, M. E. K. Ibrahim, E. Wilde, K. Schneider, M. Schlesier, B. Friedrich, and K. A. Malik	
Hydrogen Uptake (Hup) Plasmids: Characterization of Mutants and Regulation of the Expression of Hydrogenase	131
R. C. Tait, K. Andersen, G. Cangelosi, and S. T. Lim	
Detection of Plasmids in <u>Rhizobium japonicum</u> . . .	137
D. B. Scott and R. C. Tait	
Chemolithotrophy in <u>Rhizobium</u>	141
H. J. Evans, J. E. Lepo, F. J. Hanus, K. Purohit, and S. A. Russell	
Hydrogen Uptake (Hydrogenase) Activity of <u>Rhizobium japonicum</u> Strains Forming Nodules in Soybean Production Areas of the U.S.A.	159
S. T. Lim, S. L. Uratsu, D. F. Weber, and H. H. Keyser	
D. Genetic Regulation of Stress Tolerance	
Proline Over-Production Enhances Nitrogenase Activity Under Osmotic Stress in <u>Klebsiella</u> <u>pneumoniae</u>	173
D. Le Rudulier, S.-S. Yang, and L. N Csonka	

Selection of Naturally Occurring Stress Tolerant <u>Rhizobium</u>	181
D. N. Munns, K. G. Cassman, and H. H. Keyser	

III. PLANT FACTORS IMPACTING NITROGEN ASSIMILATION

A. Measurements and Efficiency of N₂ Fixation

Evaluating Potentially Superior <u>Rhizobium</u> Strains in Soybeans	195
L. E. Williams, S. S. Jue, K. G. Cassman, and D. A. Phillips	

Physiological Interactions Between Alaska Peas and Strains of <u>Rhizobium leguminosarum</u> That Differ in Plasmid-Like Genes	207
T. M. DeJong, N. J. Brewin, and D. A. Phillips	

Evaluating Elite Alfalfa Lines for N ₂ -Fixation Under Field Conditions	217
G. H. Heichel, C. P. Vance, and D. K. Barnes	

Successes and Problems Encountered While Breeding for Enhanced N ₂ Fixation in Alfalfa	233
D. K. Barnes, G. H. Heichel, C. P. Vance, D. R. Viands, and G. Hardarson	

B. Photosynthesis and Nitrogen Utilization

Biochemical Genetics of Ribulose Bisphosphate Carboxylase/Oxygenase: High Frequency Transfer and Chromosome Mobilization by Broad Host-Range R-Factors in CO ₂ -Fixing Bacteria	249
K. Andersen	

Photosynthetic Enzyme Regulation by the Ferredoxin/Thioredoxin and the Ferralaterin Mechanisms	257
B. B. Buchanan	

Regulation of Photosynthetic CO ₂ Fixation	279
J. T. Bahr and J. J. Steffens	

Hydrolysis of Ribulose-1,5-Bisphosphate Carboxylase by Partially Purified Endoproteinases of Senescing Primary Barley Leaves	293
B. L. Miller and R. C. Huffaker	

The Relationship Between Ribulose Bisphosphate Carboxylase Concentration and Photosynthesis . . .	305
J. W. Friedrich and R. C. Huffaker	

IV. NITROGEN FIXATION BY NONLEGUMES

Nitrogen Fixation by Cyanobacterial Heterocysts	315
C. P. Wolk	
Photosynthate Limitation of Nitrogen Fixation in the Blue-Green Alga, <u>Anabaena variabilis</u>	333
H. Spiller, J. F. Haury, and K. T. Shanmugam	
Physiological Studies on N ₂ -Fixing <u>Azolla</u>	343
G. A. Peters, O. Ito, V. V. S. Tyagi, and D. Kaplan	
Application of <u>Azolla</u> in Crop Production	363
S. N. Talley, E. Lim, and D. W. Rains	
A New Woody Plant Which Fixes Nitrogen: <u>Chamaebatia foliolosa</u> (Rosaceae)	385
R. M. Heisey and C. C. Delwiche	
Soil Factors Limiting Nodulation and Nitrogen Fixation in <u>Purshia</u>	395
T. L. Righetti and D. N. Munns	

V. CONSERVATION OF FIXED NITROGEN

A. Denitrification

Overview of Denitrification	411
W. J. Payne and M. A. Grant	
The Physiological Genetics of Denitrification in <u>Pseudomonas</u>	429
C. A. Carlson and J. L. Ingraham	
On Regulating the Synthesis of Nitrate Reductase	445
C. A. Carlson	
The Conversion of NO ₃ ⁻ to NH ₄ ⁺ in <u>Klebsiella</u> <u>pneumoniae</u>	451
J. R. Thayer and R. C. Huffaker	

Denitrification by the Photosynthetic Bacterium, <u>Rhodopseudomonas sphaeroides</u> Forma Sp. <u>Denitrificans</u> : Mechanism of Electron Transport to Nitrate and Nitrite Reduction	463
T. Satoh, E. Sawada, and M. Bannai	
Production of Nitrous Oxide as a Product of Nitrite Metabolism by Enteric Bacteria	473
T. Satoh, S. S. M. Hom, and K. T. Shanmugam	
Use of Nitrogen-13 and Nitrogen 15 in Studies on the Dissimilatory Fate of Nitrate	481
J. M. Tiedje	
Soil Denitrification	499
D. D. Focht	
B. Acquisition and Assimilation of Plant Nitrogen	
Nitrate Transport Processes and Compartmentation in Root Systems	517
W. A. Jackson and R. J. Volk	
Reduction of Nitrate and Nitrite in Barley Leaves in Darkness	533
M. Aslam, R. C. Huffaker, and C. C. Delwiche	
Influence of Light and CO ₂ on Nitrate Assimilation by Barley Seedlings	541
M. Aslam, R. C. Huffaker, D. W. Rains, and K. P. Rao	
Light Interaction With Nitrate Reduction	547
S. L. Morrison, R. C. Huffaker, and C. R. Guidara	
Interaction Between NO ₃ ⁻ , NO ₂ ⁻ , and NH ₄ ⁺ During Assimilation in Detached Barley Leaves	561
S. S. Goyal and R. C. Huffaker	
Vacuolar Nitrate and the Isolation of Vacuoles for Localization and Transport Studies	569
R. Granstedt and R. C. Huffaker	
The Effect of pH, Temperature, and NO ₃ ⁻ Concentration on NH ₄ ⁺ Absorption and N ₂ (C ₂ H ₂)- Fixation by Soybeans	579
L. Marcus-Wyner and D. W. Rains	

Recurrent Divergent and Mass Selections in Maize With Physiological and Biochemical Traits: Preliminary and Projected Application	581
R. H. Hageman and R. J. Lambert	
Inheritance of Nitrate Reductase	599
S. Heath-Pagliuso and R. C. Huffaker	
Modelling Dynamic Aspects of Nitrogen in Soils and Plants	605
H. van Keulen	
Integration of Nitrate and Ammonium Assimilation in Higher Plants	623
R. Novoa, R. S. Loomis, and D. K. McDermitt	
A New Approach to the Analysis of Reductive and Dissipative Costs in Nitrogen Assimilation . .	639
D. K. McDermitt and R. S. Loomis	
Strategies for Achieving Self Sufficiency in Nitrogen on a Mixed Farm in Eastern Canada Based on Use of the Faba Bean	651
D. G. Patriquin, D. Burton, and N. Hill	
LIST OF PARTICIPANTS	673
INDEX	681