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# PHYSIOLOGICAL ASPECTS OF CROP YIELD

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# PHYSIOLOGICAL ASPECTS OF CROP YIELD

Proceedings of a symposium sponsored by the University of Nebraska, the American Society of Agronomy, and the Crop Science Society of America, and held at the University of Nebraska, Lincoln, Nebr., January 20-24, 1969. Financial support for the symposium came from the Rockefeller Foundation. Publication assistance was provided through the International Biological Program.

## Editorial Committee

### JERRY D. EASTIN, Chairman

*Plant Physiologist, Cereal Crops Research Branch, Crops Research Division, Agricultural Research Service, US Department of Agriculture, and Associate Professor, Department of Agronomy, University of Nebraska, Lincoln, Nebraska.*

### F. A. HASKINS

*Professor, Department of Agronomy, University of Nebraska, Lincoln, Nebraska*

### C. Y. SULLIVAN

*Associate Professor, Department of Horticulture and Forestry, University of Nebraska, Lincoln, Nebraska*

### C. H. M. VAN BAVEL

*Professor, Institute of Life Sciences, Texas A & M University, College Station, Texas*

Managing Editor: RICHARD C. DINAUER

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## FOREWORD

This volume is the outgrowth of an international symposium held at Lincoln, Nebraska, January 20-24, 1969. It was sponsored by the University of Nebraska in cooperation with the American Society of Agronomy and the Crop Science Society of America with partial financing by the Rockefeller Foundation and the International Biological Program.

The symposium planning committee was broadly based and was able to bring specialists from many parts of the world to the conference. Thus, the technical presentations were drawn from outstanding authorities backed up by a clear perspective of social needs. This was a happy combination which contributed greatly to the success of the conference and is shown on the printed pages of this book. Happy, too, is the realization that in this symposium the most basic of inquiry into the physiology of plants is brought to bear on solving problems of the yield of economic plants vital to man's existence, both now and in the long view ahead. Empiricism, successful in past decades will, we are convinced, be augmented and in some cases be replaced by the new understanding of the physiology of yield in plants.

We sometimes hear that research is less enjoyable and rewarding now than formerly, partly because it is so fragmented. The output is so great that no one can keep up with more than a mere fraction of research reports and relating one part with another is often difficult. We believe the symposium presented here in book form has bridged some of these chasms.

There is no reason why science cannot be put to work somewhere to assist man in his eternal quest to control his environment and satisfy his basic needs and ambitions. However, there are many examples of misguided or abortive "advances" which produce short-term or local gains at the risk of much larger long-term losses. Hence, as was brought out at the symposium, a certain level of technology must be evaluated in terms of its cost, its worth, and the goals men hold. The societies which sponsored this undertaking are dedicated to the encouragement of excellent science and to the dissemination of knowledge. We believe this book represents a positive and useful effort toward both.

July 1969

L. P. Reitz, President, CSSA  
W. L. Nelson, President, ASA

## PREFACE

Mounting world population pressures and accompanying malnutrition problems pose grave concerns in the minds of thoughtful men. The nature, scope, and impending gravity of this situation has been ably characterized by Dr. J. J. Harrar, President of the Rockefeller Foundation. In a stimulating address during the symposium, Dr. Harrar identified the two principal approaches toward alleviating malnutrition as (i) increased food production per unit land area and (ii) population control. This symposium was concerned with the first approach.

Despite the considerable genetic sophistication incorporated into current plant breeding techniques, C. M. Donald describes plant breeding approaches as being largely empirical (*Advances in Agronomy*, Vol. 15) because our knowledge and use of yield-related physiological and morphological characters is meager. Crop physiologists and biochemists must continue to provide plant breeders with criteria for tailoring crops to different environments, and plant breeders in turn must recognize and use these criteria in their programs.

Plant production processes must be better understood if maximum economic yields are to be realized and exploited. The competitive advantage of any biologic organism in the field, be it crop plant or pest, is dictated by its relative response to the prevailing environment. Environmental physiology research has scarcely touched on interdependencies amongst and control of the major physiologic processes dictating competitive advantage. Quantitating the environment and plant morphologic characters simultaneously with major physiologic process rates may provide much essential perspective concerning the order of these yield limiting factors. The subsequent exploitation of these yield-related factors will depend on their detailed characterization at cellular and molecular levels.

Life processes, in the final analysis, are the sum total of biochemical reactions at cellular and molecular levels. The manner in which these reactions interrelate dictates the efficiency with which light energy is trapped in the plant, converted to chemical energy, and elaborated into storage products useful to man. A significant, increased rate of progress in breeding for yield will depend on expanded, interrelated advances in disciplines such as environmental physiology, systems analyses, simulation and bioinstrumentation, anatomy and morphology, cell biology, and genetics. This symposium was keyed to reviewing and highlighting selected aspects of knowledge in some of these diverse disciplines in an attempt to bridge some of the gaps between essential field and molecular level research pertaining to higher crop yields.

The Rockefeller Foundation approved a five-year grant in 1966 to the Nebraska Agricultural Experiment Station in support of a research program entitled "The Physiology of Yield and Management of Sorghum in Relation to Genetic Improvement." A sum was included in the grant budget to assist in financing a symposium concerning the application of physiological principles in the improvement of crop yields.

Arrangements were made for the American Society of Agronomy and the Crop Science Society of America to cooperate with the University of Nebraska in sponsoring the symposium. The symposium planning committee members were Drs. F. A. Haskins (chairman), J. M. Daly, Jerry D. Eastin, and C. Y. Sullivan, representing the University of Nebraska and appointed by Dr. H. W. Ottoson, Director of the Nebraska Agricultural Experiment Station; Dr. C. H. M. van Bavel, representing the ASA, appointed by Dr. R. S. Whitney, then President of the ASA; and Dr. R. W. Howell, representing the CSSA, appointed by Dr. A. A. Hanson, then President of the CSSA.

The symposium was held from January 20 to 24, 1969, at the Nebraska Center for Continuing Education, as one of the first events in the Centennial observance of the University of Nebraska. Registration at the symposium totalled approximately 445 persons. A total of 40 states and the District of Columbia in the USA, and 14 countries outside the USA were represented at the conference.

A complete listing of all those who have helped the planning and editorial committees is not feasible. However, the committees do wish to acknowledge publicly the excellent contributions of all speakers, invited discussants, and session chairmen. The names of the speakers and of those invited discussants who elected to submit copy for this volume are shown in the Table of Contents. Two of the invited discussants made excellent verbal presentations but chose not to submit copy for publication. They were Drs. C. B. Tanner, University of Wisconsin, and V. T. Walhood, ARS, USDA. One of the invited discussants, Dr. R. W. Allard, University of California, Davis, was unable to attend the symposium.

Chairmen of the eight half-day sessions were the following: Dr. H. H. Kramer, Purdue University; Dr. D. E. McCloud, University of Florida; Dr. C. H. M. van Bavel, Texas A and M University; Dr. G. E. van Riper, Deere and Company; Drs. R. W. Howell and F. G. Viets, ARS, USDA; and Dr. E. F. Frolik and H. W. Ottoson, University of Nebraska.

The contributions of the following in various phases of planning and conducting the symposium and/or publishing this volume also merit special mention:

Drs. Sterling Wortman and Lewis M. Roberts of the Rockefeller Foundation

Dr. A. B. Ward of the Nebraska Center for Continuing Education

Drs. D. C. Smith and F. L. Patterson, Past-Presidents of the ASA and CSSA, respectively

Drs. W. L. Nelson and L. P. Reitz, Presidents of the ASA and CSSA, respectively

Dr. Matthias Stelly and Mr. R. C. Dinauer of the ASA Hdqtrs. staff

The financial support of the Rockefeller Foundation has already been mentioned. Without it, this symposium would not have been possible. The financial contribution of the International Biological Program toward the publication of this volume also is acknowledged with thanks.

July 1969

The Editorial Committee: Jerry D. Eastin (chairman); F. A. Haskins; C. Y. Sullivan; C. H. M. van Bavel.

# CONTRIBUTORS

Donald N. Baker	Soil Scientist, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Boll Weevil Research Laboratory, State College, Mississippi
Harry Beevers	Professor of Biology, Department of Biological Sciences, Purdue University, Lafayette, Indiana
Orlin Biddulph	Professor of Botany and Director of Molecular Biophysics Laboratory, Washington State University, Pullman, Washington
Robert F. Chandler, Jr.	Director, International Rice Research Institute, Manila, Philippines
Marion Clawson	Director, Land Use and Management Program, Resources for the Future, Inc., Washington, D.C.
Harry F. Clements	Senior Plant Physiologist, Emeritus, and Consulting Plant Physiologist, Retired, Hawaii Agricultural Experiment Station and C. Brewer and Company, Ltd., Honolulu, Hawaii
Alden S. Crafts	Professor of Botany, Emeritus, Botany Department, University of California, Davis, California
O. T. Denmead	Senior Research Scientist, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia
William G. Duncan	Professor of Plant Physiology, Department of Agronomy, University of Kentucky, Lexington, Kentucky
Pieter Gaastra	Doctor, Centre for Plant Physiological Research, Wageningen, The Netherlands
Norman E. Good	Professor of Plant Biochemistry and Physiology, Department of Botany and Plant Pathology, Michigan State University, East Lansing, Michigan

- Richard H. Hageman      Professor of Crop Physiology, Department of Agronomy, University of Illinois, Urbana, Illinois
- John B. Hanson      Professor of Plant Physiology, Department of Botany, University of Illinois, Urbana, Illinois
- John Heslop-Harrison      Professor, Institute of Plant Development, University of Wisconsin, Madison, Wisconsin
- Yoshiaki Ishizuka      Dean, Faculty of Agriculture, Hokkaido University, Sapporo, Hokkaido, Japan
- Peter R. Jennings      Leader, Inter-American Rice Program, Centro Internacional De Agricultura Tropical, Colombia, South America
- Neal F. Jensen      Professor of Plant Breeding, Department of Plant Breeding and Biometry, Cornell University, Ithaca, New York
- Dov Koller      Professor, Department of Botany, The Hebrew University of Jerusalem, Israel (formerly Visiting Research Professor, Laboratory of Nuclear Medicine and Radiation Biology, University of California, Los Angeles, California)
- Paul J. Kramer      Professor, Department of Botany, Duke University, Durham, North Carolina
- George G. Laties      Professor, Department of Botanical Sciences, University of California, Los Angeles, California
- Edgar Lemon      Research Soil Scientist, Microclimate Investigations, Soil and Water Conservation Research Division, Agricultural Research Service, U.S. Department of Agriculture, Cornell University, Ithaca, New York
- R. S. Loomis      Professor, Department of Agronomy and Range Science, University of California, Davis, California
- Walter E. Loomis      Formerly with Southern Illinois University, Carbondale, Illinois (now Professor of Botany, Department of Botany, Iowa State University, Ames, Iowa)



- K. J. McCree Associate Professor, Institute of Life Science, Texas A & M University, College Station, Texas
- Terence A. Mansfield Doctor, Department of Biological Sciences, University of Lancaster, United Kingdom
- John Lennox Monteith Professor, School of Agriculture, University of Nottingham, Sutton Bonington, Loughborough, United Kingdom
- Dale N. Moss Professor, Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota
- Yoshio Murata Head, Division of Plant Physiology, National Institute of Agricultural Sciences, Konosu, Saitama, Japan
- Werner L. Nelson Senior Vice President, American Potash Institute, West Lafayette, Indiana
- J. J. Oertli Associate Professor of Soil Science, Department of Soils and Plant Nutrition, University of California, Riverside, California
- John R. Philip Chief Research Scientist, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia
- Ralph O. Slatyer Professor of Biology, Research School of Biological Sciences, Australian National University, Canberra, Australia
- George F. Sprague Research Agronomist, Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland
- Volkmar Stoy Doctor, Swedish Seed Association, Svalöf, Sweden
- Carroll Arthur Swanson Professor of Plant Physiology, Faculty of Organismic and Developmental Biology, Ohio State University, Columbus, Ohio
- Akira Tanaka Professor of Plant Nutrition, Faculty of Agriculture, Hokkaido University, Sapporo, Japan

- |                            |  |
|----------------------------|--|
| <b>J. W. Tanner</b>        | Professor, Department of Crop Science,<br>Ontario Agricultural College, University<br>of Guelph, Guelph, Ontario, Canada |
| <b>Gillian N. Thorne</b>   | Doctor, Rothamsted Experimental Station,<br>Harpenden, Herts, United Kingdom   |
| <b>E. Bruce Tregunna</b>   | Assistant Professor, Botany Department,<br>University of British Columbia, Vancou-<br>ver, British Columbia, Canada      |
| <b>Paul E. Waggoner</b>    | Chief Climatologist, The Connecticut Agri-<br>cultural Experiment Station, New Haven,<br>Connecticut                     |
| <b>William A. Williams</b> | Professor of Agronomy, Department of<br>Agronomy and Range Science, University<br>of California, Davis, California       |
| <b>Israel Zelitch</b>      | Head, Department of Biochemistry, The<br>Connecticut Agricultural Experiment Sta-<br>tion, New Haven, Connecticut        |

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