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Principles of Soil and Plant Water Relations **Water Relations of Plants** *Water Relations of Plants and Soils* **Methods of Studying Plant Water Relations Plant Physiological Ecology** Advances in Selected Plant Physiology Aspects **Plant Breeding for Water-Limited Environments** *Methods of Studying Plant Water Relations* Stable Isotopes and Plant Carbon-Water Relations **Physiological Plant Ecology II Plant Water Relations and Growth Under Stress Plant Physiology, Development and Metabolism** Physicochemical and Environmental Plant Physiology **Water and Plant Life** Forages, Volume 2 Heavy Metal Stress in Plants **Physiology of Woody Plants Water and Life Advances in Plant Ecophysiology Techniques** *Plant Physiological Ecology* **Photosynthesis and Production in a Changing Environment** Transport in Plants II **Response of Crops to Limited Water Water Deficits and Plant Growth Climate Change and Terrestrial Ecosystem Modeling Plant & Soil Water Relationships: A Modern Synthesis Terrestrial Biosphere-Atmosphere Fluxes** Guide to Plant Water Relations Kit **Plant Responses and Control of Water Balance** *Water Dynamics in Plant Production, 2nd Edition* **Forty years of research on plant water relations** Physiological Plant Ecology II **Plants and Microclimate Water Relations in Membrane Transport in Plants and Animals Advances in Selected Plant Physiology Aspects A Manual on the Theory and Measurement of Plant-soil Water Relations Methods of Studying Plant Water Relations Plant Aquaporins** *Water and Plant Disease* **Plant Water Relations**

As plant physiology increased steadily in the latter half of the 19th century, problems of absorption and transport of water and of mineral nutrients and problems of the passage of metabolites from one cell to another were investigated, especially in Germany. JUSTUS VON LIEBIG, who was born in Darmstadt in 1803, founded agricultural chemistry and developed the techniques of mineral nutrition in agricul ture during the 70 years of his life. The discovery of plasmolysis by NAGEL! (1851), the investigation of permeability problems of artificial membranes by TRAUBE (1867) and the classical work on osmosis by PFEFFER (1877) laid the foundations for our understanding of soluble substances and osmosis in cell growth and cell mechanisms. Since living membranes were responsible for controlling both water movement and the substances in solution, "permeability" became a major topic for investigation and speculation. The problems then discussed under that heading included passive permeation by diffusion, Donnan equilibrium adjustments, active transport processes and antagonism between ions. In that era, when organelle isolation by differential centrifugation was unknown and the electron microscope had not been invented, the number of cell membranes, their thickness and their composition, were matters for conjecture. The nature of cell surface membranes was deduced with remarkable accuracy from the reactions of cells to substances in solution. In 1895, OVERTON, in U. S. A. , published the hypothesis that membranes were probably lipid in nature because of the greater penetration by substances with higher fat solubility. A STUDY OF

PLANTS-CLIMATE AND THE IMPACTS OF CHANGE UPON VEGETATION. Presenting an analysis of the water relationships of the major groups of organisms: fungi, plants and animals, the text examines water stress at all levels of biological organization. Topics covered include: 1) organic osmotic agents: their distributions, modes of action, and mechanisms of regulation; 2) desiccation stress; mechanisms for preserving cellu lar integrity under conditions of low cellular water activity; 3) water stress and water compartmentation in plants; and 4) freezing stress: the prevention and regulation of ice formation in biological fluids, and mechanisms for overcoming the damaging effects of low temperatures on cellular integrity. Common adaptive strategies in diverse organisms are emphasized, as well as the fundamental physical-chemical properties of aqueous solutions that establish the nature of the interactions among water, low molecular weight solutes and macromolecules. The majority of the world's people depend research work should be carried out at the local and regional level by locally trained on plants for their livelihood since they grow them for food, fuel, timber, fodder and people. many other uses. A good understanding Following the success of our earlier book of the practical factors which govern the (Techniques in Bioproductivity and Photo synthesis; Pergamon Press, 1985), which productivity of plants through the process of photosynthesis is therefore of paramount was translated into four major languages, importance, especially in the light of cur the editors and contributors have exten rent concern about global climate change sively revised the content and widened the and the response of both crops and natural scope of the text,· so it now bears a title ecosystems. in line with current concern over global The origins of this book lie in a series of climate change. · In particular, we have training courses sponsored by the United added chapters on remote sensing, con Nations Environment Programme (Project trolled-environment studies, chlorophyll No. FP/6108-88-0l (2855); 'Environment fluorescence, metabolite partitioning and changes and the productivity of tropical the use of mass isotopes, all of which grasslands'), with additional support from techniques are increasing in their applica many international and national agencies. tion and importance to this subject area. Heavy metal phytotoxicity has been known for more than a century. However, research in the past years has confirmed the immense damage by metal pollution to plants, the soil and ultimately to humans. By reviewing both field and laboratory work, this book deals with the various functional and ecological aspects of heavy metal stress on plants and outlines the scope for future research and the possibilities for remediation. Forages: The Science of Grassland Agriculture, 7th Edition, Volume II will extensively evaluate the current knowledge and information on forage agriculture. Chapters written by leading researchers and authorities in grassland agriculture are aggregated under section themes, each one representing a major topic within grassland science and agriculture. This 7th edition will include two new additional chapters covering all aspects of forage physiology in three separate chapters, instead of one in previous editions. Chapters will be updated throughout to include new information that has developed since the last edition. This new edition of the classic reference serves as a comprehensive supplement to An Introduction to Grassland Agriculture, Volume I. This handbook covers the most commonly used techniques for measuring plant response to biotic and abiotic stressing factors, including: in vitro and in vivo bioassays; the study of root morphology, photosynthesis (pigment content, net photosynthesis, respiration, fluorescence and thermoluminiscence) and water status; thermal imaging; the measurement of oxidative stress markers; flow cytometry for measuring cell cycle and other physiological parameters; the use of microscope techniques for studying plant microtubules; programmed-cell-death; last-generation techniques (metabolomics, proteomics, SAR/QSAR); hybridization methods; isotope techniques for plant and soil studies; and the measurement of detoxification pathways, volatiles, soil microorganisms, and computational biology. Fluxes of

trace gases, water and energy - the 'breathing of the biosphere' - are controlled by a large number of interacting physical, chemical, biological and ecological processes. In this interdisciplinary book, the authors provide the tools to understand and quantitatively analyse fluxes of energy, organic compounds such as terpenes, and trace gases including carbon dioxide, water vapour and methane. It first introduces the fundamental principles affecting the supply and demand for trace gas exchange at the leaf and soil scales: thermodynamics, diffusion, turbulence and physiology. It then builds on these principles to model the exchange of water, carbon dioxide, terpenes and stable isotopes at the ecosystem scale. Detailed mathematical derivations of commonly used relations in biosphere-atmosphere interactions are provided for reference in appendices. An accessible introduction for graduate students and a key resource for researchers in related fields, such as atmospheric science, hydrology, meteorology, climate science, biogeochemistry and ecosystem ecology. O. L. LANGE, P. S. NOBEL, C. B. OSMOND, and H. ZIEGLER In the original series of the Encyclopedia of Plant Physiology, plant water relations and photosynthesis were treated separately, and the connection between phenomena was only considered in special chapters. O. STOCKER edited Vol ume III, Pjlanze und Wasser/Water Relations of Plants in 1956, and 4 years later, Volume V, Parts I and 2, Die COrAssimilation/The Assimilation of Carbon Dioxide appeared, edited by A. PIRSON. Until recently, there has also been a tendency to cover these aspects of plant physiology separately in most text books. Without doubt, this separation is justifiable. If one is specifically inter ested, for example in photosynthetic electron transport, in details of photophos phorylation, or in carbon metabolism in the Calvin cycle, it is not necessary to ask how these processes relate to the water relations of the plant. Accordingly, this separate coverage has been maintained in the New Series of the Encyclopedia of Plant Physiology. The two volumes devoted exclusively to photosynthesis are Volume 5, Photosynthesis I, edited by A. TREBST and M. AVRON, and Volume 6, Photosynthesis II, edited by M. GIBBS and E. LATZKO. When consider ing carbon assimilation and plant water relations from an ecological point of view, however, we have to recognize that this separation is arbitrary. To write a handbook of methods is surely to invite criticism, as has already been said several times. On the other hand, there is a great need for methodological manuals in all fields of science. It was therefore decided to compile this book, written in good faith to help scientists, teachers and students who will, it is hoped, use it and judge it good. To be useful to the reader, such a manual must provide a broad review of the methods available and describe them in sufficient detail to permit preliminary selection and judgement. It has to give - at least for selected methods - a suffi ciently detailed description of the equipment and procedure as to be to some extent self-contained. It must assume a critical standpoint as regards the theoretical basis of the methods, the significance of results, and their errors and limitations. It must also furnish examples, pertinent numerical tables, and very complete references. All this and much more is expected of a good manual of methods. Principles of Soil and Plant Water Relations, 2e describes the principles of water relations within soils, followed by the uptake of water and its subsequent movement throughout and from the plant body. This is presented as a progressive series of physical and biological interrelations, even though each topic is treated in detail on its own. The book also describes equipment used to measure water in the soil-plant-atmosphere system. At the end of each chapter is a biography of a scientist whose principles are discussed in the chapter. In addition to new information on the concept of celestial time, this new edition also includes new chapters on methods to determine sap flow in plants dual-probe heat-pulse technique to monitor water in the root zone. Provides the necessary understanding to address advancing problems in water availability for meeting ecological requirements at local, regional and global scales Covers plant anatomy: an essential component to understanding soil and plant

water relations This 33-chapter volume presents a critical examination of the importance of stable isotopes in understanding key plant metabolic processes. Carbon isotope analyses for estimates of plant water use and metabolism Integrated estimates of stress impacts and life history in ecological systems Hydrogen and oxygen isotope analyses for evaluating water sources and transpiration Use of stable isotopes in scaling from leaf to global levels Sections include: History and Theoretical Considerations, Ecological Aspects of Carbon Isotope Variation, Agricultural Aspects of Carbon Isotope Variation, Genetics and Isotopic Variation, Water Relations and Isotopic Composition The book provides general principles and new insights of some plant physiology aspects covering abiotic stress, plant water relations, mineral nutrition and reproduction. Plant response to reduced water availability and other abiotic stress (e.g. metals) have been analysed through changes in water absorption and transport mechanisms, as well as by molecular and genetic approach. A relatively new aspects of fruit nutrition are presented in order to provide the basis for the improvement of some fruit quality traits. The involvement of hormones, nutritional and proteomic plant profiles together with some structure/function of sexual components have also been addressed. Written by leading scientists from around the world it may serve as source of methods, theories, ideas and tools for students, researchers and experts in that areas of plant physiology. Aquaporins are channel proteins that facilitate the diffusion of water and small uncharged solutes across cellular membranes. Plant aquaporins form a large family of highly divergent proteins that are involved in many different physiological processes. This book will summarize the recent advances regarding plant aquaporins, their phylogeny, structure, substrate specificity, mechanisms of regulation and roles in various important physiological processes related to the control of water flow and small solute distribution at the cell, tissue and plant level in an ever-changing environment. Water Relations in Membrane Transport in Plants and Animals contains the presentations in a symposium dealing with Water Relations in Membranes in Plants and Animals, during the 27th Annual Fall Meeting of the American Physiological Society held at The University of Pennsylvania, 17-19 August 1976. The purpose of the symposium was to explore the common modes of water regulation in plants and animals. In these proceedings, the mechanisms employed to restrict water flow across plant and metazoan animal cells are described. Putative differences in mechanisms of water regulation retained by plant versus animal cells become inconsequential in the light of the numerous similarities: dependence upon bioelectric potentials maintained across cell membranes, energy dependence of uphill water movement, and solute coupling during water transport. The presentations can be organized into four. The first takes up specific mechanisms of water transport in plants. The second and third parts deal with specific mechanisms in invertebrates and vertebrates, respectively. The fourth part covers generalized mechanisms common to plants and animals. Water Deficits and Plant Growth, Volume III: Plant Responses and Control of Water Balance focuses on the influence of water deficits on shrinkage of plant tissues, seed germination, reproductive growth, and internal plant responses such as protoplasmic resistance to desiccation, enzymatic activity, nitrogen metabolism, hormonal relations, and mineral nutrition. This book also considers alleviation and control of water deficits in plants. This volume is organized into 10 chapters and begins with an overview of shrinkage and swelling in plant tissues and their biological implications, along with some basic aspects of seed germination and environmental factors affecting germination as well as its relation to soil moisture. The discussion then shifts to the impact of water deficits on growth of fruits at different stages of development, from flowering to fruit ripening, and the ability of the protoplasm to survive a serious reduction in water content (known as protoplasmic resistance). The following chapters explore the effects of water deficits on enzyme activity, nutrient availability, nitrogen

metabolism, and hormonal distribution in plants. This book also looks at transpiration in plants and how to reduce it, and then concludes with a chapter on soil water conservation as a problem of management of available water resources in the context of agriculture. This book is a valuable resource for scientists and investigators in fields such as botany, plant pathology, forestry, and agriculture. Woody plants such as trees have a significant economic and climatic influence on global economies and ecologies. This completely revised classic book is an up-to-date synthesis of the intensive research devoted to woody plants published in the second edition, with additional important aspects from the authors' previous book, Growth Control in Woody Plants. Intended primarily as a reference for researchers, the interdisciplinary nature of the book makes it useful to a broad range of scientists and researchers from agroforesters, agronomists, and arborists to plant pathologists and soil scientists. This third edition provides crutial updates to many chapters, including: responses of plants to elevated CO2; the process and regulation of cambial growth; photoinhibition and photoprotection of photosynthesis; nitrogen metabolism and internal recycling, and more. Revised chapters focus on emerging discoveries of the patterns and processes of woody plant physiology. * The only book to provide recommendations for the use of specific management practices and experimental procedures and equipment *Updated coverage of nearly all topics of interest to woody plant physiologists * Extensive revisions of chapters relating to key processes in growth, photosynthesis, and water relations * More than 500 new references * Examples of molecular-level evidence incorporated in discussion of the role of expansion proteins in plant growth; mechanism of ATP production by coupling factor in photosynthesis; the role of cellulose synthase in cell wall construction; structure-function relationships for aquaporin proteins Water is the most basic essential for plant growth; an inadequate supply causes severe problems, as plants rely on the water transmitted by soil to meet their physiological and nutritional needs. Since the first edition was published, flooding and droughts throughout the world have made water an even more topical subject, as the importance and instability of our water supplies have been brought to the forefront of daily life. This new edition of Water Dynamics in Plant Production focuses on the dynamics of water through the hydrologic cycle and the associated mechanisms that plants employ to optimize growth and development. It describes the basic scientific principles of water transport in the soil-plant atmosphere continuum, and explains the linkage between transpirational water use and dry matter production. Paying particular attention to the various agronomic strategies for adaptation to climate-driven limitations of water resources, the efficiency of water use in plant production and in achieving an economic yield is presented in detail. This book offers a multidisciplinary introduction to the fundamentals and applications of water dynamics in natural and managed ecosystems. Including text boxes throughout, as well as online supplementary material, it provides an essential state of-the-art resource for students and researchers of soil and plant science, hydrology and agronomy. This text is the successor volume to Biophysical Plant Physiology and Ecology (W.H. Freeman, 1983). The content has been extensively updated based on the growing quantity and quality of plant research, including cell growth and water relations, membrane channels, mechanisms of active transport, and the bioenergetics of chloroplasts and mitochondria. One-third of the figures are new or modified, over 190 new references are incorporated, the appendixes on constants and conversion factors have doubled the number of entries, and the solutions to problems are given for the first time. Many other changes have emanated from the best laboratory for any book, the classroom. · Covers water relations and ion transport for plant cells; diffusion, chemical potential gradients, solute movement in and out of plant cells · Covers interconnection of various energy forms; light, chlorophyll and accessory photosynthesis pigments, ATP and NADPH · Covers forms in which energy and matter enter and

leave a plant; energy budget analysis, water vapor and carbon dioxide, water movement from soil to plant to atmosphere O. L. LANGE, P. S. NOBEL, C. B. OSMOND, and H. ZIEGLER In the original series of the Encyclopedia of Plant Physiology, plant water relations and photosynthesis were treated separately, and the connection between phenomena was only considered in special chapters. O. STOCKER edited Vol ume III, Pjlanze und Wasser/Water Relations of Plants in 1956, and 4 years later, Volume V, Parts I and 2, Die COrAssimilation/The Assimilation of Carbon Dioxide appeared, edited by A. PIRSON. Until recently, there has also been a tendency to cover these aspects of plant physiology separately in most text books. Without doubt, this separation is justifiable. If one is specifically inter ested, for example in photosynthetic electron transport, in details of photophos phorylation, or in carbon metabolism in the Calvin cycle, it is not necessary to ask how these processes relate to the water relations of the plant. Accordingly, this separate coverage has been maintained in the New Series of the Encyclopedia of Plant Physiology. The two volumes devoted exclusively to photosynthesis are Volume 5, Photosynthesis I, edited by A. TREBST and M. AVRON, and Volume 6, Photosynthesis II, edited by M. GIBBS and E. LATZKO. When consider ing carbon assimilation and plant water relations from an ecological point of view, however, we have to recognize that this separation is arbitrary. Water stress and heat stress are considered to be two primary factors that limit crop production in many parts of the world. Global warming appears to be increasing the water requirements of plants. Understanding the impact of water deficit on plant physiological processes and efficient water management are of great concern in maintaining food production to meet ever increasing world food demand. The book addresses various climatic soil and plant factors that contribute to the water use efficiency in plants subjected to water stress. It covers all issues related to soil, plant and climatic factors that contribute to the crop responses to water stress. The books advances the knowledge in improving and sustaining crop yields in ever increasing unpredictable climatic fluctuations This book uses crop simulation models for response of crops to limited water under various management and climatic conditions. Box 9E. 1 Continued FIGURE 2. The C–S–R triangle model (Grime 1979). The strategies at the three corners are C, competiti- winning species; S, stress-tolerating s- cies; R,ruderalspecies. Particular species can engage in any mixture of these three primary strategies, and the m- ture is described by their position within the triangle. comment briefly on some other dimensions that Grime's (1977) triangle (Fig. 2) (see also Sects. 6. 1 are not yet so well understood. and 6. 3 of Chapter 7 on growth and allocation) is a two-dimensional scheme. A C—S axis (Com- tition-winning species to Stress-tolerating spe- Leaf Economics Spectrum cies) reflects adaptation to favorable vs. unfavorable sites for plant growth, and an R- Five traits that are coordinated across species are axis (Ruderal species) reflects adaptation to leaf mass per area (LMA), leaf life-span, leaf N disturbance. concentration, and potential photosynthesis and dark respiration on a mass basis. In the five-trait Trait-Dimensions space,79%ofallvariation worldwideliesalonga single main axis (Fig. 33 of Chapter 2A on photo- A recent trend in plant strategy thinking has synthesis; Wright et al. 2004). Species with low been trait-dimensions, that is, spectra of varia- LMA tend to have short leaf life-spans, high leaf tion with respect to measurable traits. Compared nutrient concentrations, and high potential rates of mass-based photosynthesis. These species with category schemes, such as Raunkiaer's, trait occur at the ''quick-return'' end of the leaf e- dimensions have the merit of capturing cont- nomics spectrum. Water Deficits and Plant Growth, Volume V: Water and Plant Disease presents a comprehensive treatment of the role of water deficits and excesses in the plant disease complex. This book highlights water relations of diseased plants and the effects of water stress induced by disease and environmental factors, along with water deficits related to disease and water stress as a predisposing factor in plant

disease. This volume is organized into nine chapters and begins with an overview of the water relations of diseased plants, focusing on root, foliar, and shoot diseases, as well as vascular wilts. The following chapters examine the effects of water deficits on pathogen and host, the degree and duration of water deficits as predisposing factors in plant disease, and important abiotic diseases induced by water deficits and excess. The discussion then turns to water in relation to active and passive liberation of spores, as well as to the infection process. This book also explains soil moisture in relation to spread and survival of pathogens, the link between water and seed decay, field and storage fungi that affect seeds, and water in relation to wood deterioration. This volume concludes with a chapter on moisture as a factor in epidemiology and the forecasting of disease. This book is a valuable resource for scientists and investigators in fields such as botany, plant pathology, forestry, agriculture, and biology. This volume will be the only existing single-authored book offering a science-based breeder's manual directed at breeding for water-limited environments. Plant breeding is characterized by the need to integrate information from diverse disciplines towards the development and delivery of a product defines as a new cultivar. Conventional breeding draws information from disciplines such as genetics, plant physiology, plant pathology, entomology, food technology and statistics. Plant breeding for water-limited environments and the development of drought resistant crop cultivars is considered as one of the more difficult areas in plant breeding while at the same time it is becoming a very pressing issue. This volume is unique and timely in that it develops realistic solutions and protocols towards the breeding of drought resistant cultivars by integrating knowledge from environmental science, plant physiology, genetics and molecular biology. To write a handbook of methods is surely to invite criticism, as has already been said several times. On the other hand, there is a great need for methodological manuals in all fields of science. It was therefore decided to compile this book, written in good faith to help scientists, teachers and students who will, it is hoped, use it and judge it good. To be useful to the reader, such a manual must provide a broad review of the methods available and describe them in sufficient detail to permit preliminary selection and judgement. It has to give - at least for selected methods - a suffi ciently detailed description of the equipment and procedure as to be to some extent self-contained. It must assume a critical standpoint as regards the theoretical basis of the methods, the significance of results, and their errors and limitations. It must also furnish examples, pertinent numerical tables, and very complete references. All this and much more is expected of a good manual of methods. Water Relations of Plants attempts to explain the importance of water through a description of the factors that control the plant water balance and how they affect the physiological processes that determine the quantity and quality of growth. Organized into 13 chapters, this book first discusses the functions and properties of water and the plant cell water relations. Subsequent chapters focus on measurement and control of soil water, as well as growth and functions of root. This book also looks into the water absorption, the ascent of sap, the transpiration, and the water stress and its effects on plant processes and growth. This book will be useful for students, teachers, and investigators in both basic and applied plant science, as well as for botanists, agronomists, foresters, horticulturists, soil scientists, and even laymen with an interest in plant water relations. Provides an essential introduction to modeling terrestrial ecosystems in Earth system models for graduate students and researchers. This book focuses on the fundamentals of plant physiology for undergraduate and graduate students. It consists of 34 chapters divided into five major units. Unit I discusses the unique mechanisms of water and ion transport, while Unit II describes the various metabolic events essential for plant development that result from plants' ability to capture photons from sunlight, to convert inorganic forms of nutrition to organic forms and to synthesize high energy molecules, such as ATP. Light signal perception and transduction

works in perfect coordination with a wide variety of plant growth regulators in regulating various plant developmental processes, and these aspects are explored in Unit III. Unit IV investigates plants' various structural and biochemical adaptive mechanisms to enable them to survive under a wide variety of abiotic stress conditions (salt, temperature, flooding, drought), pathogen and herbivore attack (biotic interactions). Lastly, Unit V addresses the large number of secondary metabolites produced by plants that are medicinally important for mankind and their applications in biotechnology and agriculture. Each topic is supported by illustrations, tables and information boxes, and a glossary of important terms in plant physiology is provided at the end. Physiological plant ecology is primarily concerned with the function and performance of plants in their environment. Within this broad focus, attempts are made on one hand to understand the underlying physiological, biochemical and molecular attributes of plants with respect to performance under the constraints imposed by the environment. On the other hand physiological ecology is also concerned with a more synthetic view which attempts to under stand the distribution and success of plants measured in terms of the factors that promote long-term survival and reproduction in the environment. These concerns are not mutually exclusive but rather represent a continuum of research approaches. Osmond et al. (1980) have elegantly pointed this out in a space-time scale showing that the concerns of physiological ecology range from biochemical and organelle-scale events with time constants of a second or minutes to succession and evolutionary-scale events involving communities and ecosystems and thousands, if not millions, of years. The focus of physiological ecology is typically at the single leaf or root system level extending up to the whole plant. The time scale is on the order of minutes to a year. The activities of individual physiological ecologists extend in one direction or the other, but few if any are directly concerned with the whole space-time scale. In their work, however, they must be cognizant both of the underlying mechanisms as well as the consequences to ecological and evolutionary processes. The book provides general principles and new insights of some plant physiology aspects covering abiotic stress, plant water relations, mineral nutrition and reproduction. Plant response to reduced water availability and other abiotic stress (e.g. metals) have been analysed through changes in water absorption and transport mechanisms, as well as by molecular and genetic approach. A relatively new aspects of fruit nutrition are presented in order to provide the basis for the improvement of some fruit quality traits. The involvement of hormones, nutritional and proteomic plant profiles together with some structure/function of sexual components have also been addressed. Written by leading scientists from around the world it may serve as source of methods, theories, ideas and tools for students, researchers and experts in that areas of plant physiology. Water Relations of Plants and Soils, successor to the seminal 1983 book by Paul Kramer, covers the entire field of water relations using current concepts and consistent terminology. Emphasis is on the interdependence of processes, including rate of water absorption, rate of transpiration, resistance to water flow into roots, soil factors affecting water availability. New trends in the field, such as the consideration of roots (rather than leaves) as the primary sensors of water stress, are examined in detail. Addresses the role of water in the whole range of plant activities Describes molecular mechanisms of water action in the context of whole plants Synthesizes recent scientific findings Relates current concepts to agriculture and ecology Provides a summary of methods

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- Plant Water Relations And Growth Under Stress
- Plant Physiology Development And Metabolism
- Physicochemical And Environmental Plant Physiology
- Water And Plant Life
- Forages Volume
- Heavy Metal Stress In Plants
- Physiology Of Woody Plants
- Water And Life
- Advances In Plant Ecophysiology Techniques
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- Photosynthesis And Production In A Changing Environment
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- Response Of Crops To Limited Water
- Water Deficits And Plant Growth
- Climate Change And Terrestrial Ecosystem Modeling
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