



# **MATHEMATICAL MODELS OF CROP GROWTH AND YIELD**

**ALLEN R. OVERMAN  
RICHARD V. SCHOLTZ III**

# Mathematical Models Of Crop Growth And Yield

**Carol A. Singer**



## **Mathematical Models Of Crop Growth And Yield:**

Mathematical Models of Crop Growth and Yield Allen R. Overman, Richard V. Scholtz III, 2002-08-27 Highlighting effective analytical functions that have been found useful for the comparison of alternative management techniques to maximize water and nutrient resources this reference describes the application of viable mathematical models in data analysis to increase crop growth and yields Featuring solutions to various differential equations Introduction to Mathematical Modeling of Crop Growth Christopher B. S. Teh, 2006 Learning mathematical modeling need not be difficult Unlike other books this book not only lists the equations one by one but explains in detail how they are each derived used and finally assembled into a computer program for model simulations This book shows how mathematics is applied in agriculture in particular to modeling the growth and yield of a generic crop Topics covered are agriculture meteorology solar radiation interception and absorption evapotranspiration energy and soil water balance soil water flow photosynthesis respiration and crop growth development Rather than covering many modeling approaches but in superficial detail this book selects one or two widely used modeling approaches and discusses about them in depth Principles learned from this book equips readers when they encounter other modeling approaches or when they develop their own crop models **A Memoir on**

**Mathematical Models of Crop Growth and Yield** Allen R. Overman, 2008 This memoir is the eighth in a series related to Mathematical Models of Crop Growth and Yield The series focuses on ideas which have been found useful in describing crop response to applied nutrients N P and K and accumulation of biomass and mineral elements with calendar time No attempt has been made to survey the broad field of crop modeling Results have evolved out of work with farmers and engineers over a period of nearly forty years There has been extensive collaboration with other scientists in Florida as well as other regions within the USA Analysis has been drawn from the large array of data from research conducted around the world over 150 years While basic concepts from physics chemistry and biology have been incorporated the models have been developed at the field scale for the sake of application Methods of applied mathematics and statistics have been utilized to provide a more rigorous foundation to the models Procedures from regression and analysis of variance have been borrowed from statistics In fact this is the focus of the present memoir As often occurs in research the question is how to analyze a complex set of data For example response of biomass and mineral uptake to applied nutrients N P and K where some other management factor such as intercropping is varied as well Is it appropriate to average over the response variables Are there some parameters in the model which are common among different management factors One can make such judgments based either on visual inspection of data or on statistical analysis The goal is to simplify the analysis as much as can be justified Throughout this analysis analytical functions have been used in contrast to numerical procedures A particular set of data for response of corn Zea mays L to applied N P and K is used to illustrate the analytical procedures The extended logistic model describes the data rather well Coupling of biomass yield and plant N uptake is achieved with a hyperbolic phase relation The memoir

contains 36 pages including 19 references 21 tables and 11 figures

**A Memoir on Mathematical Models of Crop Growth and Yield** Allen R. Overman, 2008 Two mathematical models have been developed to couple plant biomass and mineral elements N P and K Both models use analytical functions in contrast to numerical procedures The growth model describes accumulation of biomass with calendar time due to photosynthesis It contains a linear partition function between light gathering and structural plant components an exponential aging function and a Gaussian energy driving function Accumulation of plant nutrients is coupled to biomass through a hyperbolic phase relation Accumulation of biomass appears to be the rate limiting process in the system The seasonal model assumes logistic dependence of plant nutrient accumulation on applied nutrient Biomass is coupled to plant nutrient through a hyperbolic relation The model has been extended to cover response to multiple levels of N P and K Both models have been shown to apply to annuals and perennial grasses In this document the models are applied to field studies from several geographic locations and planting times to clarify values of model parameters The phase relations for the growth model imply that biomass accumulation by photosynthesis is the rate limiting process in the field studies which have been analyzed and that accumulation of mineral elements proceeds in virtual equilibrium

*A Memoir on Mathematical Models of Crop Growth and Yield* Allen R. Overman, 2007 Two mathematical models have been developed to couple plant biomass and mineral elements N P and K Both models use analytical functions in contrast to numerical procedures The growth model describes accumulation of biomass with calendar time due to photosynthesis It contains a linear partition function between light gathering and structural plant components an exponential aging function and a Gaussian energy driving function Accumulation of plant nutrients is coupled to biomass through a hyperbolic phase relation Accumulation of biomass appears to be the rate limiting process in the system The seasonal model assumes logistic dependence of plant nutrient accumulation on applied nutrient Biomass is coupled to plant nutrient through a hyperbolic relation The model has been extended to cover response to multiple levels of N P and K Both models have been shown to apply to annuals and perennial grasses In this document the models are applied to a variety of examples to further confirm the general applicability Data from the literature are used extensively

Introduction to Mathematical Modeling of Crop Growth Christopher Teh, 2006-04-21 Learning mathematical modeling need not be difficult Unlike other books this book not only lists the equations one by one but explains in detail how they are each derived used and finally assembled into a computer program for model simulations This book shows how mathematics is applied in agriculture in particular to modeling the growth and yield of a generic crop Topics covered are agriculture meteorology solar radiation interception and absorption evapotranspiration energy and soil water balance soil water flow photosynthesis respiration and crop growth development Rather than covering many modeling approaches but in superficial detail this book selects one or two widely used modeling approaches and discusses about them in depth Principles learned from this book equips readers when they encounter other modeling approaches or when they develop their own crop models

**Simulation Models of Climate**

**Change** Carol A. Singer,1993      *Modeling Physiology of Crop Development, Growth and Yield* Afshin Soltani,2012-01-01  
Model studies focus experimental investigations to improve our understanding and performance of systems Concentrating on crop modelling this book provides an introduction to the concepts of crop development growth and yield with step by step outlines to each topic suggested exercises and simple equations A valuable text for students and researchers of crop development alike this book is written in five parts that allow the reader to develop a solid foundation and coverage of production models including water and nitrogen limited systems      Selected Water Resources Abstracts ,1990

**Precision agriculture '23** John V. Stafford,2023-08-14 Precision agriculture is a reality in agriculture and is playing a key role as the industry comes to terms with the environment market forces quality requirements traceability vehicle guidance and crop management Sensors now in use in agriculture are generating Big Data leading to the use of machine learning and AI an increasing challenge for agriculture Research continues to be necessary and needs to be reported and disseminated to a wide audience These edited proceedings contain peer reviewed papers presented at the 14th European Conference on Precision Agriculture held in Bologna Italy The papers reflect the wide range of disciplines that impinge on precision agriculture technology crop science soil science agronomy information technology decision support remote sensing data analysis and others The broad range of research topics reported will be a valuable resource for researchers advisors teachers and professionals in agriculture long after the conference has finished      **Selected Water Resources Abstracts** ,1991      **Rotational Grazing and Intensive Pasture Management** Ann Townsend Young,Carol A. Singer,Catherine Lynn Shull,Jane Potter Gates,Janet Saunders,Kathie Beane,Patricia La Caille John,Susan Chapman,1993      ,      **Handbook of Natural Pesticides: Methods** N. Bhushan Mandava,2018-04-19 This handbook series includes several naturally occurring chemicals that exhibit biological activity These chemicals are derived from plants insects and several microorganisms Volume I of this series is covers the theory and practice of the strategies for pest control and methods for detection Moreover it presents extensive tables that provide the information you need to select the most appropriate bioassay for a particular plant growth regulator or hormone In addition to the chapters on bioassays Volume I provides a solid introduction to the theory and practice of natural pesticide use including in depth discussions of integrated management systems for weed and pest control the state of the art use of computers in pest management and allelochemicals as natural protection Guidelines on toxicological testing and EPA regulation of natural pesticides are also detailed      **Yield Formation in the Main Field Crops** V. Cerný,L. Hruška,J. Petr,2012-12-02 This book gives a detailed overview of production processes and yield formation in field crops and permanent grasslands Yield formation is discussed by the authors as a dynamic process involving many factors at each stage Knowledge of the optimum levels of individual yield components makes it possible to control this dynamic process It is intended that this approach will help to point out gaps in the understanding of the production processes and indicate the direction for further research on this subject The authors report on various aspects which are involved in

yield formation such as uptake of nutrients root growth water use photosynthesis transport distribution and accumulation of photosynthates etc A separate chapter discusses the production process as seen from a genetic standpoint It includes an analysis of phenotype and genotype with respect to production potential also the heredity variability of yield potential and new cultivation methods are mentioned The main part of the book deals with the theory and practice of yield formation in cereals maize legumes sugarbeet potatoes clovers and perennial grass stands

**Physiology of Growth and Development in Horticultural Plants** N. R. Bhat, Arvind Bhatt, M. K. Suleiman, 2024-09-16 The development of a plant is a multifaceted dynamic phenomenon Due to their immobility plants respond not only to internal developmental cues but also to changes in the prevailing environmental conditions Climate change has increased vulnerability in plants due to increasing concentrations of CO<sub>2</sub> and other pollutants and fluctuations in the growing environment These changes affect crop growth and productivity thereby posing a major risk to global food security Physiology of Growth and Development in Horticultural Plants contains 22 chapters organized into six sections beginning with an introduction on basic concepts of plant growth and development followed by genetic basis of plant development quantification of growth and sensing and response of plants to various environmental signals It also explores plant growth hormones and their role either singly or in combination in controlling various aspects of plant growth and development and hormonal regulation of physiological and developmental processes The book highlights intricate aspects of growth and development in horticultural plants with classic examples from the real world Features Presents information on plant growth and development structure and genetic basis of plant development with quantification of growth sensing and response of plants to various environmental signals and various phytohormones and their role in controlling aspects of plant growth and development Provides key scientific and technical advances issues and challenges in various areas of growth and development of horticultural plants Demonstrates how the response of various plants to internal and external stimuli can be commercially exploited Physiology of Growth and Development in Horticultural Plants encourages the development of new techniques technologies and innovative practices and is an ideal reference for students of advanced plant sciences courses researchers and commercial horticultural practitioners

**Next-Generation Greenhouses for Food Security** Redmond R. Shamshiri, 2021-06-16 Modern greenhouse technology has revolutionized the food supply chain scenario over the past 40 years Closed field cultivation by means of agri cubes plant factories vertical farming structures and roof top solar greenhouses has become the backbone of sustainable agriculture for producing all year round fresh fruits and vegetables This book is an attempt to explore several profound questions such as how digital technology and simulation models have saved energy in commercial greenhouses and why growers prefer LPWAN sensors and IoT monitoring devices over the traditional timer based controllers How artificial intelligence is capable of performing microclimate prediction and control and what considerations should be taken into account for implementing desiccant evaporative cooling systems With case study examples and field experiments each

chapter highlights some of the most recent solutions and adaptation strategies toward improving the efficiency and sustainability of closed field crop production systems      Effects of Carbon Dioxide Enrichment on Plant Growth Carol A. Singer,1992      **EPA-600/2** ,1979      Bibliography of Agriculture with Subject Index ,1993-05

## Reviewing **Mathematical Models Of Crop Growth And Yield**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is actually astonishing. Within the pages of "**Mathematical Models Of Crop Growth And Yield**," an enthralling opus penned by a very acclaimed wordsmith, readers attempt an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve in to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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