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Book reviews

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Modeling Crop Production Systems, by PHOOL SINGH. 512 pp. Enfield, NH, USA: Science Publishers (2008).
US$ 59.50 (Softcover) ISBN 978-1-57808-418-0.

It is always a pleasure to pick up a book that brings back student days, confronts one with new ideas or reminds one of those simply now forgotten about. Singh's book offers a range of quantitative methods to tackle phenomena of general nature, entomology and crop growth. It is mainly directed to graduate and undergraduate students of agricultural and environmental science and deserves attention because it offers mathematical functions and concepts to solve biophysical problems. For research and science policy, it stresses the relevance of mathematical modelling for better exploitation of experimental data to secure sustainable development of food and energy supply. The book is based on the lectures 'Modeling of Biological Systems' originally given by S. M. Welch at Kansas State University, amended by the author's lectures at Haryana Agricultural University in Hissar, India. It contains six chapters: (1) Philosophy, role and terminology of system science; (2) Development of model structure; (3) Specification of component behavior; (4) Computer implementation; (5) Model testing and validation; and (6) Biological application of models. Of particular value to any student is the way Singh presents examples and their solutions, especially in the appendices to the last chapter. In addition, each chapter contains references to further reading, including earlier books on modelling, and there is a useful keyword index. Largely covering work from the 1970s up to the mid-1990s, it may seem a bit outdated. In the last and possibly most important chapter, however, Singh refers to recent developments, e.g. model applications to genomics.

After the introductory chapters, great detail is given to methods of analysing component behavior (chapter 3) including mathematical matrices, e.g. for population dynamics and principal component analysis. Numerous techniques of curve fitting and parameter estimation are presented including appropriate equations, their linearized forms and computer implementation. Numerical and graphical results are presented for processes in cropping systems, e.g. dynamics of pests. The principal component analysis is applied at great detail to parameters determining growth of different chickpea varieties but, unfortunately, the variables were not explained. Chapter 4, comprising more than 100 pages, describes model implementation, including different languages, general-purpose (BASIC, FORTRAN, etc.) and special-purpose programs (e.g. CSMP). References to specialized packages are given (e.g. DBMS for data management; FSE for simulation). Most of this chapter, however, is devoted to relational databases, explaining hierarchies, generalization and specialization concepts. It is a useful reference as it gives examples for the use of flowcharts, introductions to BASIC programming and different data structures (object, relational, network and hierarchy). It concludes with a sub-chapter on data systems, and unfortunately, the reader is not encouraged by a summary of how these techniques can be used in 'modelling crop production systems' (e.g. rotations, land use analysis). Chapter 5 is mainly devoted to the statistical methods of model testing and evaluation, and Singh gives the key statistical parameters that are often hidden in textbooks. Unfortunately, he does not refer to some key issues, like the effect of replicated observations on model efficiency. Moreover, reference to other, European literature on model evaluation is missing under further reading. Another drawback of this chapter is the brevity it deals with the sensitivity analysis, which has more recently received great attention in the scientific community.

The key chapter 6 presents the basics of ecological and agricultural examples of model application on about 100 pages and adds almost 80 exercises with solutions. Predator–prey systems and population dynamics take the bulk of the ecological applications while plant competition studies and environmental management (e.g. energy flow and nutrient cycling in grassland) receive less attention. Agricultural applications focus mainly on crop yield, describing the principles of light interception and conversion, potential and water limited production, including the explicit (BASIC) code. References are given to model sensitivity, their value in relation to precision farming and remote sensing. The tabulated lists of various crop model applications are not really clear with regard to their distinction and grouping. What could have been a concluding summary on the status quo

and value of model applications (advantages and limitations …) appears as a reference to a single article. The sub-chapter on Plant Disease Prediction looks much more structured and coherent; however, it refers to work that was done in the 1970s. Yield losses were expressed in terms of empirical equations, and unfortunately no detail is given on a referenced yield loss simulation model. This may be indicative of the lack of explicit integration between crop yield and epidemiological models. Some examples of these are given, continuing into the sub-chapter on Insect Phenology, modelling of population dynamics and its link to environmental factors. Instead of another small sub-chapter on 'Symbiosis between crop modelling and genomics' it might have been better to present some conclusions on the referenced work on disease and pest control in cropping systems with their challenges and opportunities. Here, another chapter concludes in a somewhat immature fashion.

Overall, the book has some breaks of style due to the fact that it merges the lectures of Welch with the more recent work of Singh himself. Some sub-chapters relevant to crop modelling seem to have been added onto the original text which focused on more general and theoretical issues of modelling. It comes over as a little bit unbalanced and in places possibly structured with too much detail while other headings sometimes suggest that something is missing. Introductions with clear objectives and conclusions added to each chapter could have enhanced clarity and offer some 'take-home' messages, which are sometimes hidden. However, in large parts the book brilliantly presents a type of 'cook-book' numerical recipes. Understanding of the text is helped by numerous diagrams and flow charts, which only sometimes remain cryptic. In conclusion, this book gives numerous basic tools and valuable information fundamental to students. Unfortunately, its gold nuggets and value for research are often hidden, and the literature review is unrefined and not always conclusive and visionary. Finally, intensive use of the book may be impaired by the poor quality of its binding, which did not survive my review.

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Plant Genotyping II: SNP Technology ed. ROBERT J. HENRY. ix+285 pp. Wallingford: CAB International. £65, US$130, €105 (Hardback). ISBN 978-1-84593-382-1.

SNP technology is fast becoming the most important methodology for discovering and detecting genetic differences between individuals. This is not just the case for plants, but for all types of organisms. In fact, the main driver for higher throughput and lower cost sequencing and SNP genotyping has come from human genetics in its relentless search for the genetic factors underlying complex diseases. This book describes the most important areas in which SNP technology has been applied in plant research, ranging from genetic mapping and dissection of complex traits, marker-assisted selection, characterization of germplasm and DNA barcoding. Chapter 1 describes methods for SNP discovery in plants and, because the emphasis is on the hexaploid wheat crop, provides a good insight into the particular challenges of genotyping in polyploid plants. It describes possible solutions to the challenge of distinguishing between true allelic, homoeologous and paralogous polymorphisms in polyploid species. Sugarcane has an even more highly polyploid genome, and chapter 5 illustrates how EcoTILLING can help in identifying SNPs in this complex genome. SNP discovery methods are described in various chapters, and in various degrees of detail. They include single strand conformation polymorphism (SSCP), TILLING/EcoTILLING, microarrays, and *in silico* methodology (including searching for SNPs in microsatellite containing sequences). However, it is difficult to avoid the conclusion that whatever the method used, validation and confirmation of SNPs have to involve sequencing. Sequencing should thus feature prominently in a book on SNP technology. The widely used Applied Biosystems capillary electrophoresis sequencing platform is described on pages 120–121, with one or two inaccuracies, such as exchanging cathode with anode. Pyrosequencing is described in several places, including its use in the '454' sequencing system, which was the first of the next generation sequencing technologies. The Solexa system is only mentioned, and since then ABI has launched its SOLID system. It illustrates the pace with which this technology is developing and the difficulty of keeping a book on this subject completely up to date. However, chapter 9 does provide fascinating insight into emerging nanotechnology-based sequencing and genotyping methods, promising further miniaturization and lower cost per assay. There are a host of existing SNP detection systems available. The MassARRAY system, pyrosequencing and allele-specific PCR are well described. I am surprised that the Illumina Bead Array system is not mentioned, but I can appreciate that it is difficult to give an exhaustive treatment of all available technologies. There is an example of marker use for selecting rice genotypes with improved fragrance qualities, but no comparable examples given for complex traits. This is still to come. This book is slightly expensive, given that all figures are in black and white. Nevertheless, it gives a flavour of many of the current technologies, and their potential