Book Review

Breeding for Quantitative Traits in Plants

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Stemma Press, Woodbury, MN55125, 2002. Hardback, 369 pp. ISBN 0-9720724-0-3

Knowledge of the scientific background of plant breeding is indispensable for correct decisions at all steps of the breeder´s work. Breeding is improving plants to meet specific human demands. Many plant traits of economic importance are quantitative rather than qualitative. In contrast to qualitative traits, which are controlled by one or few genes, quantitative traits are characterised by a continuum of phenotypes and are controlled by the joint action of many genes. The tools for studying the genetic architecture of quantitative traits originate from the progress in genomic and post-genomic science.

The author uses his experience at a private seed company and his lectures at the Purdue University. The book was written as a textbook for graduate courses for the application of quantitative genetics in plant breeding. The author therefore assumes some basic knowledge of plant breeding and statistics. Mathematical notation generally follows the common terms of quantitative genetics, but readers are often guided to more specialised references. Basic matrix algebra understanding is also required, although a brief introduction to matrix algebra is included.

The book is divided into five main parts, from introduction to the fundamental concepts, based on the one-locus model, up to the exploitation of information on genes controlling quantitative traits. An epilogue considers how to continue with breeding for complex quantitative traits in plants.

The first part, called *Plant breeding and population genetics*, gives a general introduction to the study of quantitative traits (modes of plant reproduction, population structures and types of cultivars, and breeding of self-pollinated and cross-pollinated crops), and continues with genetics of breeding populations. It covers the Hardy-Weinberg equilibrium, deviations from it, and estimation of genetic relatedness using molecular markers.

In the second part *Mean performance of a breeding population*, the main principles of creating breeding populations with improved performance are summarised in two chapters. The discussion concentrates on phenotypic and genotypic values and the selection of parents for maximum mean performance. The theoretical conclusions are supported by examples from plant breeding.

The third part, *Variation in breeding populations*, explains phenotypic, genetic and environmental components of variance, describes the estimation of genetic variance and ends with genotype × environment interactions. Here also practical examples are given for the estimation and prediction of genetic variance, the application of AMMI models (Additive Main and Multiplicative Interaction), etc.

The selection of best genotypes from breeding populations and finalising them into cultivars is the cardinal purpose of the breeder´s work. In the part *Selection in the breeding populations*, selection and prediction methods are described, such as pedigree and testcross selection, recurrent selection, selection for multiple traits, best linear unbiased prediction (BLUP), heterosis and hybrid prediction. The BLUP method, which allows, besides others, to analyse unbalanced data and to exploit information from relatives, is explained briefly and clearly (the author is one of the leading world experts). In the chapter are given practical examples of the use of BLUP in self- and cross-pollinated crops and within a breeding population and of restricted maximum likelihood (REML) estimation using matrices.

In the last part of the book, *Breeding with gene information*, the author admits, that the chapters 13 to 15 cover fast-developing fields and will be likely a bit outdated in a few years. In the chapter devoted

to mapping of quantitative trait loci (QTL), the characteristics of genes in QTLs are discussed, basic knowledge of molecular markers and genetic maps is summarised, and general approaches to linkage mapping of QTLs are described. Much of this chapter is about methods and examples of QTL mapping in structured populations. The next chapter is about selection with molecular markers, describing consistency of QTL effects, QTL × environment interactions. Many empirical results from QTL mapping experiments in barley, potato, rice, sorghum, sunflower, tomato, and wheat are discussed. The efficiency of marker-assisted selection (MAS) is compared with phenotypic selection. At the end of this chapter examples of successful marker assisted selection are given.

In the epilogue to the book the author meditates about the use of BLUP with genotypic data and phenotypic selection (TG-BLUP) and the future of breeding for quantitative traits with regard to the complexity of the plant.

There are only a few books about quantitative genetics on the market. *Breeding for Quantitative Traits in Plants* is a well-arranged, clearly and well-written comprehensive book not only for students, but also for scientists and practising plant breeders. Readers can find here answers to many questions and also useful instructions for their work.

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The book was purchased from the grant of the Ministry of Education, Youth and Sports of the Czech Republic (No. LI01004) and is available at the Library of the Agricultural Research Institute Kroměříž, Ltd., Kroměříž, Havlíčkova 2787, 76701 Kroměříž, Czech Republic. Contact: kroftova@vukrom.cz