

BOOK REVIEWS

comprehensive overview of molecular evolution of colour-vision pigments as well as adaptive evolution of dim-light vision. The authors describe how a total of 30 amino-acid variations can explain a lot of variations in the spectral range of vision among different species. The author's own unpublished observations suggest that evolution of a new spectral range due to variation in the sequence in a species may not get reversed if reverse mutation happens. Interestingly, colour vision and colour blindness seem to confer different selective advantages, which according to the author could be the reason for their co-existence throughout evolutionary history. This article is a must read for anyone interested in molecular basis of evolution.

The article on infectious disease in the genomics era does not live up to its expectations, with no illustrations and no section on metagenomics; a field which has assumed extreme importance in understanding host-pathogen interactions. Surprisingly, a topic on metagenomics seems to have not been covered in any of the previous editions. Article 15 reviews the molecular mechanism of pathogenesis in Thoracic Aortic Aneurism and Dissection (TAAD), wherein genetic mutations in smooth muscle cells as well as hypertension could result in SMC contractile dysfunction triggering stress and/or stretch pathways leading to degradation of elastic fibres and accumulation of proteoglycans. This holistic understanding may lead to the development of rational therapeutics targeting different components of SMC contractile dysfunction pathways. Studies of polymorphisms in drug response genes for TAAD might be of pharmacogenetic relevance.

The power of the model systems to understand gene function is well elaborated in the article on ENU mutagenesis in mice. It was intriguing to learn from the article, that ENU-induced mutation in mice in at least 18 different genes shows different phenotypes from corresponding knockouts. The authors have also pointed out that ENU mutagenesis, which leads to point mutations, can give better insights into the pathobiology of human disease states than null alleles. With the availability of the genome sequence and a plethora of standardized phenotypic scoring schemes, it is possible to identify mutants through both forward and reverse genetics approach. The following article by Bejjani and Shaffer describes

clinical utility of recent advancements in molecular cytogenetics through an example of the discovery of CHD7 mutations causing CHARGE syndrome. The article describes the power of combining genomic techniques with cytogenetics (array CGH) in establishing molecular causes of well-known clinical conditions. The article also provides new insights into genomic architecture (CNV) contributing to syndromic conditions. These methods promise to aid in the clinical evaluation of diseases in the near future. Article 17 on genetic predisposition to breast cancer is one of the most comprehensive chapters of the book. The article highlights refinements in the methodologies of detection of genes predisposing to cancer. This chapter clearly indicates that despite technological advancements more than 70% of breast cancer predisposition remains unexplained. BRCA1 and BRCA2 remain the most prominent, followed by a few intermediate and low-penetrance alleles. However, the author is still optimistic that GWA studies, that have promised more than they could deliver, and de novo sequencing are likely to reveal novel variations and pathways for the identification of markers for risk assessment and therapeutic intervention.

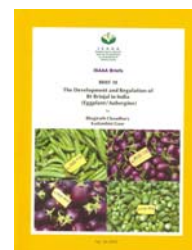
The article on the history and science of the Utah reference project gives an account of the usefulness of creation of a reference set of samples in which phenotyping and genotyping measurements have provided an enormous resource for human genome mapping to the discovery of QTL loci, which explains the difference between normal individuals, provides genetic clues on tasters/non-tasters, aging, telomere length, etc. It also details how community participation, timeliness of this creation and establishment of cell lines of these reference samples have contributed a wealth of information to the human genome project.

The last chapter describes how the analyses of African genetic diversity can help map genes of complex diseases. Campbell and Tishkoff explain the out-of-Africa theory from mitochondrial and Y-chromosomal data, and describe population bottleneck effects during migration to the other parts of the world. The article also explains the concept of the linkage disequilibrium and how its comparison between African (ancient) and European (recent) population groups can help trace genetic history. The authors have also outlined the uniqueness of several

diseases among Africans, e.g., their protection against malaria, their dietary adaptations, the high prevalence of AIDS, etc. A detailed population sampling across the continent and whole-genome sequencing of many individuals and/or large-scale SNP genotyping in different populations will potentially yield many new susceptibility alleles for complex diseases as well as pave the path towards personalized medicine. The authors have also cautioned that researchers should not forget about the ethical issues while doing large-scale population-based studies, which has been dealt with in greater detail in article 9 in the light of direct-to-consumer (DTC) genetic testing. This article highlights the issues and the need for considering ethical, legal and social factors in DTC. It compares and contrasts the policies in Europe and USA, and points out that most of the researchers are unaware of this highly important field and a lot more needs to be done in this direction. India has a wealth of genetic resource ideal for mapping complex traits and providing genetic markers which are likely to be applicable in global populations. Indian initiatives in genomics need to align themselves to the conceptual framework outlined in the articles described above. In summary, this volume is contemporary and provides an excellent educative collection as promised by its earlier editions.

MITALI MUKERJI*
ARIJIT MUKHOPADHYAY

*Genomics and Molecular Medicine Unit,
Institute of Genomics and Integrative
Biology (CSIR),
Mall Road, Delhi 110 007, India
e-mail: mitali@igib.res.in



The Development and Regulation of Brinjal in India (Eggplant/Aubergine). B. Choudhary and K. Gaur. ISAAA Brief No. 38, ISAAA, Ithaca, NY, USA. 2009. 102 pp. Price:

This book recently published by ISAAA (International Service for the Acquisition

of Agri-Biotech Applications) provides a comprehensive review on all aspects of brinjal (eggplant, *Solanum melongena*) cultivation and also describes the efforts made in developing *Bt* brinjal to control its major lepidopteron pest, the fruit and shoot borer (FSB) – *Leucinodes arbonalis*. This peer-reviewed document is available from the ISAAA South Asia Office at New Delhi and is also accessible, free of charge, on its websites www.isaaa.org and www.isaaa.org/kc.

The book is divided into four parts comprising ten chapters. The first part describes the genetic diversity, biology, production and importance of brinjal as a vegetable crop, grown on about 550,000 ha in India, and the challenge posed in its production by the FSB, which has been responsible for 60–70% yield loss despite heavy application of chemical insecticides.

The second part deals with the application of biotechnology in crop improvement and provides an insight into genetic engineering, wherein the desired genes from unrelated organisms such as a bacterium like *Bacillus thuringiensis* can be isolated and introduced into a plant species to impart particular traits like insect resistance, herbicide tolerance, etc. It furnishes valuable global statistics on the status and performance of various genetically engineered/modified (GE/GM) crops. It also emphasizes that a 67-fold increase in the area of GM crops in about 12 years from 1.7 m ha in six countries in 1996, the first year, to 114.3 m ha in 23 countries in 2007 is unprecedented in the adoption of any new technology in agriculture. The chapter also highlights that in India, *Bt*-cotton, the first and until now the only biotech crop commercialized, is a remarkable success with its area increasing from 50,000 ha in 2002, the first year, to 6.2 m ha in 2007 (a 124-fold increase in 6 years), providing safe and effective control of bollworms resulting in higher yields, reduced application of insecticides and greater profit to the farmers. It emphasizes the need to extend the GM/*Bt* technology to vegetable/food crops to derive such benefits.

The third part describes the biology of FSB and its nature of damage, and ex-

plains the scientific procedures involved in developing *Bt* brinjal for its control. The larvae of FSB bore into tender shoots as well as fruits, retarding plant growth and damaging fruits up to 95%, causing great economic losses. Since the larvae lead a concealed life within the shoots or fruits, they normally escape insecticides. FSB-resistant *Bt* brinjal has been developed by Maharashtra Hybrid Seed Company (MAHYCO), using genetic engineering and transformation process similar to the one deployed in *Bt* cotton. As in *Bt* cotton, *Bt* brinjal has been incorporated with the modified *cryIAc* gene originally derived from the soil bacterium, *Bacillus thuringiensis*. The insecticidal protein produced by this gene is specific to lepidopteron insects like FSB and is environmental-friendly. When FSB larvae feed on any part of the *Bt* brinjal plant, they ingest the *Bt* protein which gets activated in the alkaline gut, binds to specific receptors in the gut wall leading to its breakdown, allowing the *Bt* spores to invade the insect's body cavity, finally leading to its death within a few days. While MAHYCO has introduced the *Bt* gene into brinjal hybrids developed by it, the company has generously donated the same technology to the Tamil Nadu Agricultural University, Coimbatore and to the University of Agricultural Sciences, Dharwad, to introduce the *Bt* gene into open-pollinated brinjal varieties. Thus, the *Bt* technology will be available to farmers both in hybrids as well as varieties of brinjal. Other private and public institutions are also in the process of developing their own *Bt* brinjal technology. Thus, there is an encouraging private–public partnership.

In the fourth and final chapter, the authors describe the prevailing multi-tier regulatory framework in India for approval of biotech products and give details of various biosafety studies that *Bt* brinjal has undergone from 2002 to date. These include toxicity and allergenicity evaluation as well as nutritional studies on rabbits, rats, carps, goats, broiler chickens and dairy cows which have confirmed that *Bt* brinjal is as safe as its non-*Bt* counterparts. The safety of *Bt* brinjal was further validated by the results of studies on pol-

len flow, impact on soil microflora and microfauna, effect on non-target organisms, agronomy, invasiveness, *Bt* protein degradation and also the proactive methods recommended for insect resistance management. Field studies have indicated that *Bt* brinjal provides effective control of FSB, resulting in significant increase in the yield. It is estimated that it would deliver farmers a net economic benefit ranging from Rs 16,299 (US\$ 330) to Rs 19,744 (US\$ 397) per acre, with national benefits to India exceeding US\$ 400 million per year. Furthermore, the significant decrease in insecticide usage will reduce its residues in brinjal fruits and the environment and also farmers' exposure to insecticides. A list of vegetable improvement programmes and vegetable seed companies in India is also given.

Bt brinjal has completed all the bio-safety studies prescribed by the Indian regulatory authorities and established its safety to humans, animals and the environment. On the approval of the Genetic Engineering Approval Committee, Ministry of Environment and Forests, Govt of India, it is now undergoing multilocation large-scale field trials and seed production – the final stage of regulatory approval – and is all set to be the second GM crop after *Bt* cotton, or the first vegetable GM crop, to be approved in India. Those who doubt the safety and benefits of *Bt* brinjal should go through this book to seek scientific clarifications. The book is rich in technical content, with 28 tables and 23 figures, carries an informative foreword by Clive James and provides useful references to more than 120 publications. It is a one-stop shop on brinjal/*Bt*-brinjal for scientists and common readers alike. The authors need to be congratulated on their efforts in writing this useful and timely book.

T. M. MANJUNATH

Agri-Biotechnology & IPM,
'SUMA', 174 G Block,
Sahakaranagar,
Bangalore 560 092, India
e-mail: manjunathm@gmail.com