

The Current Issue of *Science* devotes a section to Plant Genomes & Biotechnology

Austin, 26th April, '06. The GNOBB members either interested or involved in plant genomes and GM crops research will find it interesting to glance through the special section on, "Green Genes" published in the 25th April's edition of *Science*. The section contains 16 articles on multiple areas of biotechnology and evolution of plant genomes. Most of the information given here is already known but scattered in a wide variety of literature. Thus, this section, written by experts is unique as it covers almost all areas concerning plant genomes and their application in plant improvement. More.... to see the list of articles and their summaries. The names of the author(s) for each article are given within parenthesis except for two where the names are not mentioned.

With the help of a map the first article on **GM crops: the World View** gives a list of the eight countries, namely, Argentina, Brazil, Canada, China, India, Paraguay, South Africa and USA which in 114 million ha produce most of the GM crops of mainly four taxa, namely, soy, maize, canola and cotton. Some countries allow import of finished products derived from GM crops but do not grow the crop themselves.

One article (Dean DellaPenna and Robert L. Last) describes how the genomes contain blueprints for different metabolic pathways and how evolutionarily they developed to become highly complex. In another article the authors (A. R. Leitch and I. J. Leitch) account for the preponderance of polyploidy in plants in contrast to animals. The phenomenon of polyploidy gives the plant species an advantage for their adaptation to different climates and environmental niches. In an attempt to discover the genomic relationship between different plant taxa, the authors (Haibao Tang, John E. Bowers, Xiyin Wang, Ray Ming, Maqsudul Alam, and Andrew H. Paterson) in another article discuss the use of molecular tools such as synteny and collinearity; and whether there is an occurrence of two or more homologous gene sequences in different species (ortholog) or gene pairs derived from the same ancestral gene (paralog). In another article gene regulation is discussed from a systems network perspective to show how the phenotype of an individual is affected by natural variation and environmental inputs.

About golden rice, one article (Martin Enserink) says that although 10 years back it was produced at the laboratory, it has not been marketed not on account of its demerit as much as due to the intense lobbying against it by the GM antagonists. For the same reason transgenic ringspot virus resistant papaya could not find market outside the Hawaiian islands, although the bioengineered variety saved the papaya industry from wreck (Erik Stokstad).

The article under the title: *Multimedia Feature: Plant Genomes – is an Interactive Presentation* featuring information graphics, video commentary, and an animation, presented under four subtitles: Genome complexities, Insights, GM Crops, Future directions. The video graphically describes in an animated fashion how chromosomal changes such as inversion, translocation, duplication and deletion sometimes increase and sometimes reduce the genome size and cause structural changes leading to phenotypic variation. Unlike the animal kingdom which includes humans chromosomal changes in plants are not only tolerated but in certain cases give them an adaptive advantages to climate changes and other edaphic factors. contributing to

Following a steep increase in gas prices, attention of biotech scientists has been focused on unconventional plants such as switchgrass (*Panicum virgatum*) and *Miscanthus*. The article (Eli Kintisch) dealing with planting of high energy plants describes the above two plant species having potential for use as energy crops. The article also mentions that bioengineering more efficient energy plants needs to include more hemicellulose in the cell wall, so that they might be more easily digestible by biofuel-processing enzymes. The article describes the keen interest of the U.S. Department of Energy (DOE), in providing several million dollars over 5 years to bring genomics to bear on biofuels. The article concludes, quoting Dr. Christopher Somerville, "It's important to cast a wide net for biofuel crops. There's still a lot of uncertainty about what the optimal species are."

In another interesting article, the author (Jocelyn Kaiser) describes the kind of research being carried out on using GM plants to make human proteins and other pharmaceutical products including oral vaccines. The article surveys the development of biopharming from an initial enthusiasm to a loss of interest by giant drug companies due to technological hurdles and mishaps as a result of contamination of soy fields by the sprouting of leftover biopharmed corn seeds. There has been recent revival of the drug companies' interest in biopharming, when an Israel based company, Protalix applied for licensing their recombinant product glucocerebrosidase produced in cultured carrot cells. Currently the product, used for treatment of a rare inherited disease, Gaucher costs a patient \$200,000 a year but it will be a lot cheaper when the drug will be extracted commercially from transgenic carrot cells.

To allay the fear of environmentalists, biopharma products will be either manufactured using bacteria inside the lab or produced inside the greenhouse. Technology has also been developed to upscale the production to make biopharmed products cheaper – a good news for the people of the developing world. The paper concludes with a statement that "Once two or three products win approval, the field should really take off."

The article (Philip N. Benfey and Thomas Mitchell-Olds) on, “from Genotype to Phenotype” discusses that in spite of our success in sequencing genomes of several organisms such as human, chimpanzee, mouse, chicken, dog, worm, fly, rice, and cress and a variety of other taxa, we have still a long way to go to know what genes do - when it comes to the expression of a trait by polygenes. However, with the rapid advancement of technology, the information on the involvement of particular genes in human diseases and those important to agriculture will soon be revealed elucidating as to how the phenotype of an organism is changed due to a gene’s altered function.

The article (John Travis) on sequencing of grape genome underscores the importance of such an undertaking that has provided grape breeders a powdery mildew resistant gene derived from the Central Asian grape variety used for raisins.

Explaining the larger genome size in plants compared to taxa of the remaining kingdoms the authors (Brandon S. Gaut and Jeffrey Ross-Ibarra) in this article attribute this trait to three factors, namely, gene duplication; b) tandem duplication and c) accumulation of transposons in the genome. The authors point out that as much as 40% genome size difference have been found to characterize different plant populations within the species. Even within higher plants the genome size varies from the 64-Mb characteristic of *Genlisea* (corkscrew plants) to the 124-Gb genome size of *Fritillaria* (the fritillary lilies) in the ratio of 1:2000. The role of transposons is unfolding. Previously they were considered to be deleterious but recent findings indicate that transposons have been domesticated to become functional genes by means of insertions of complete exons into expressed genes.

In the article, “The Epigenetic Landscape of Plants”, the author (Xiaoyu Zhang) describes how the molecular events such as DNA methylation, histone modifications, and RNA interference regulate chromatin structure and control transcription. Microarray and high throughput sequencing studies have enabled researchers to gain insights in the hitherto little understood pathways.

The 16 articles to be found in this issue of *Science* are listed below:

Introduction to Special Issue - Green Genes: Laura M. Zahn, Pamela J. Hines, Elizabeth Pennisi, and John Travis

GM Crops: A World View : Name(s) of author(s) not mentioned

Tough Lessons from Golden Rice: Martin Enserink

Papaya Takes on Ringspot Virus and Wins: Erik Stokstad

Uncorking the Grape Genome: John Travis

Sowing the Seeds for High-Energy Plants: Eli Kintisch

A Life With Grapes: John Travis

Genome-Enabled Approaches Shed New Light on Plant Metabolism: Dean DellaPenna and Robert L. Last

Genomic Plasticity and the Diversity of Polyploid Plants: AR Leitch & IJ Leitch;
Multimedia Feature: Plant Genomes – An Interactive Presentation featuring information graphics, video commentary, and an animation. Names of authors not mentioned.

Components of Angiosperm Genomes: Brandon S. Gaut and Jeffrey Ross-Ibarra;
Synten and Collinearity in Plant Genomes: Haibao Tang, John E. Bowers, Xiyin Wang, Ray Ming, Maqsudul Alam, and Andrew H. Paterson

Is the Drought Over for Pharming? Jocelyn Kaiser

Extending Genomics to Natural Communities and Ecosystems: Thomas G. Whitham, Stephen P. DiFazio, Jennifer A. Schweitzer, Stephen M. Shuster, Gery J. Allan, Joseph K. Bailey, and Scott A. Woolbright

The Epigenetic Landscape of Plants: Xiaoyu Zhang
From Genotype to Phenotype: Systems Biology Meets Natural Variation: Philip N. Benfey and Thomas Mitchell-Olds

PLANT GENETICS: The Blue Revolution, Drop by Drop, Gene by Gene: Elizabeth Pennisi