

# Science of Omics for Agricultural Productivity: Future Perspective - A national conference report

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## ABSTRACT

Agriculture play central role in human civilization development. As the world population continues to grow, more and more agriculture products are required to meet people's need. Advent of newer approaches of omics sciences and technologies will enable to address several issues and challenges faced by modern agriculture and also ensure food and nutritional security. Exploiting the potential of 'OMICS' technologies for agricultural productivity, plant protection, nutritional and medicinal purposes have currently been receiving a lot of attentions. This report highlighted the importance of 'OMICS' based research as future of Indian agriculture with very useful recommendations.

**Keywords:** Omics, Agricultural Productivity.

## INTRODUCTION

'OMICS' technologies, substantially transformed both the throughput and the design of scientific experimentation, have the potential to accelerate agricultural growth through development of high yielding and nutritive crop varieties. Change in paradigm i.e. the hypothesis driven approach to now experimental first then hypothesis has significantly enhanced the importance of generation of datasets, their analysis and then interpretation. Normally, a scientist addresses a scientific problem by postulating a hypothesis and working through the experimentation to prove or disprove the hypothesis. With the omics approach, asking an initial research question is not always necessary or a pre-requisite. Genome or proteome wide data can be collected in an omics experiment without an existing hypothesis, followed by generation and testing of biological hypotheses. This reversal from the 'first hypothesize-then-experiment' tradition to 'first experiment-then-hypothesize' mode of operation offers the promise to discover unprecedented patho-physiological mechanisms of

stress tolerance and other complex traits in crop plants. The amplified throughput data availability, the process of research has fundamentally been altered in '**omics science**'. The huge amount of data generated from 'OMICS' based research, through multiple levels of experimentation on gene and metabolite expression patterns underlying complex plant traits and responses has enabled to follow a systems biology approach to address problems of modern agriculture.

In view of the above, there are specific challenges and opportunities common to several high-throughput OMICS platforms that need to be addressed for their applications in accelerating agricultural growth, a three days National conference entitled "**Science of Omics for Agricultural Productivity: Future Perspective**" was organized from 4<sup>th</sup>-6<sup>th</sup> March, 2014. The National Conference was the first of its kind in the country organized by the **Pantnagar Biotechnology programme**-Department of Molecular Biology and Genetic Engineering, College of Basic Sciences, G. B. University of Agriculture and Technology, Pantnagar, under the aegis of the Society of Plant Biochemistry and

Biotechnology, New Delhi. The conference was supported by both public and private organizations. An overwhelming response was received from the scientific community and over 400 scientists and scholars registered for the conference and submitted more than 395 abstracts, out of which 335 abstracts were finally accepted. The conference was conducted in 4 plenary sessions and 10 major scientific sessions, in which latest developments in the field of 'OMICS' research were presented by leading scientists, young scientists and students through lecture and poster presentations. Apart from 52 plenary, lead and invited lectures by eminent scientists of our country, there were also 30 oral presentations by young scholars in different scientific sessions. Oral and poster presentations in the scientific sessions covered the topics from marker assisted breeding to the frontier sciences like nanotechnology, proteomics, metabolomics and other high throughput technologies.

The conference was inaugurated by the Chief Guest Padma Bhushan Dr. R. B. Singh, Former President, NAAS, New Delhi (Figure 1), who defined the term OMICS in his key note address by detailing that "OM signifies fullness, completeness as in divinity ... it encompasses the entire universe in its unlimitedness. OM, with its endless intonation, is then allied with the  $\Omega$ , the greatest and the very last character in the Greek alphabet. The remarks by Dr. Singh himself demonstrated the importance of a holistic approach of omics technologies in resolving the complex issues of agriculture. The three days National conference stirred discussions on application of the research on the DNA structure-function relationship using newer genomics, transcriptomics, proteomics and metabolic approaches for understanding the complex traits and increasing the productivity in farmer's field through generation of smart crops by genetic and genome engineering.



Figure1. Inaugural session of the OMICS-2014.

It was revealed that bioinformatics tools have a pivotal role to play in today's agriculture science research by greatly optimizing the resource inputs and the time required to take a product from laboratory to field. However, there is an urgent need to develop excellent human resource in this emerging, exciting and challenging area. The interactive session on "Keeping in pace with modern advancement in biotech education" provided a platform for free-wheeling

discussions on the current state of biotech education in India and generated tremendous response in chalking action plan and strategies for improving the biotech education in the country.

In all the scientific sessions, the lectures delivered and posters presented by young researchers (both students/scientists) from various parts of the country were thoroughly evaluated by a high level committee for selection of best paper for "Young Scientist Awards" (Figure 2). Judging from the quality of the abstracts and their presentations, it is reassuring to note that the outstanding quality and enthusiasm was maintained by the young investigators participating in OMICS-2014. A total of 24 young scientist awards were conferred to winning participants by the Chief Guest of the valedictory function, Dr. H. P. Singh, Ex-DDG, Div. of Horticulture, ICAR, New Delhi. Dr. M. Anandaraj, Director, Indian Institute of Spice Research, Kozhikode (Calicut) graced the function as Guest of Honor and also presided a scientific session on "Nano-biotechnology and Diagnostics".



Figure 2. Recipients of Young Scientists award during valedictory session of conference.

The galaxy of scientists, academicians and eminent experts from various national organizations and industries from different parts of our country actively participated and presented their views to solve the most challenging issues in agricultural productivity, using modern tools and techniques of 'OMICS' technology. The national conference **was planned for formulating and devising strategies to strengthen the efforts towards the access and application of an exponentially growing list of genome sequences, from organisms covering all three forms of life, by agricultural scientists.** A boom in exciting molecular technologies has taken the investigation of gene structure and function to an unprecedented level and more comprehensive measurement of cellular metabolites and elucidating the molecular basis of complex traits. Indeed, this conference helped in the sensitization of the young minds by provoking the thoughts for addressing many demand driven issues, resolving regional food security issues and challenges in agriculture, by adopting successful and innovative technologies. The conference also elaborated on the need for formulation of programs for using available

bio-resource wealth, for the socio economic development.

The recommendations which emerged from deliberations in conference are as follows.

- Education in Agricultural Biotechnology needs more of hands-on training and rationalization of highly descriptive teaching patterns. With recent advances and rapid changes in relevant areas of Physics, Chemistry, Agriculture and Instrumentation, promotion of teaching based on pedagogy principles, evolution of multiple skill sets with inter-disciplinary approach, sharing of on-line global information is essential for development of competitive skill sets and employable education. ***It is recommended that human resource development especially in the inter-disciplinary areas, having interface with information and communication technologies, mathematics and statistics, is required to understand, classify, interpret the big and complex genomic data by developing bioinformatics tools and to efficiently utilize the genomic resources for product development.***
- The education in biotech domain should also emphasize on innovative thinking and personality development through assisted learning and creating interest in general awareness about the current research topics and methodologies. ***It was recommended that biotech departments and colleges should ensure that rather than the band-wagon approach towards biotech courses, an aptitude based approach for entering the biotech stream should be adopted and all the institutions must provide background practical training in basic molecular biology techniques to all biotech graduates for enhancing their employability. Teaching should emphasize on classical research papers and regular seminars.***
- In order to ascertain that the rich plant bio-resources are utilized to usher optimized and sustained agricultural and economic development of people, there is need to catalogue and characterize the existing biodiversity with complete descriptor data for genotypes and chemotypes, in the form of digital databases. ***It is therefore recommended that a team involving natural scientists, IT scientists, bioinformaticians and molecular biologists be created that would promote bioinformatics interventions for bioresource utilization and facilitate whole genome sequencing of priority crop species of different regions to get new genomic information for ensuring geographic and heritage rights accordingly. However, it requires further boost in funding to create internationally competitive genomic resources centre.***
- Proteomics will add to our understanding of the biochemistry of proteins, processes and pathways for years to come. ***Since it is often difficult to predict the three dimensional structures or function of a protein based on homology to other proteins, determination of components of a protein complex or of a cellular structure is central in functional analysis. Therefore, it is recommended to develop an excellent infrastructure for actively pursuing this area having enormous applications in nutritional quality enhancement.***
- Since the complete annotation of numerous identified genes, efficient methods for simulation and analysis of various metabolic pathways and gene regulatory networks are lacking, therefore, ***plant biotechnology research must integrate system biology approach for dissecting and manipulating complex traits in agriculture.***
- In order to meet the multifaceted challenges in metabolomics and analytical technology ***there is urgent need for the automation of operations like sample preparation, derivatization chemistry and data processing for improved throughput and reproducibility, combining multiple analytical technology platforms for the same sample, combined analysis of metabolome, proteome and transcriptome, profiling of signalling molecules and other compounds occurring in traces along with those present in bulk, increasing accuracy in quantification, combining profiling with flux analysis, identification of unidentified metabolic compounds through metabolite profiling experiments.***
- The genome-wide strategies have accelerated the identification of key stress-responsive networks and their associated genes, which may be manipulated through either breeding strategies or genetic engineering. ***It is recommended that alternative approaches should aim at a genetic analysis of the entire trait and whole response complexes via analysis of quantitative trait loci (QTLs). In view of growing list of molecular markers, it is recommended that marker assisted selection (MAS) should be utilized as complementary technology in conjunction with more established conventional methods of genetic selection for plant improvement. This technology is user-friendly and can be utilized at a relatively low cost by programs with limited technological capabilities.***
- Plant tissue culture and genetic transformation technology has provided important tools for sustainable development of agriculture and forestry. However, several crops are recalcitrant and do not respond in plant tissue culture and such plants are the major challenges before developmental biologists. ***It is recommended that with depleting natural resources and***

*changing global climate, conventional agricultural practices alone are unable to sustain the quality and quantity of the produce. With advent of modern biotechnology, newer tools permitting gene transfer across the species: transgenic development through developing better plant tissue culture protocols, provide an attractive avenue for solving the recalcitrant problems.*

- Recent innovations in the field of nanobiotechnology in agriculture facilitate development of better agricultural inputs delivery system, enhanced barriers to microbial contamination or spoilage, diagnostics for detection of food-borne pathogens or spoilage organisms. ***It is recommended that each State may identify the principal area(s) in which nanobiotechnology applications is more crucial and relevant for development of agriculture technology. An Advanced Institute for Research and Education in Nanobioinformation technology should be set up in each State and be mandated with different areas and thereafter networked for integrated development.***
- Bioinoculant, Bioprocessing and Metagenomics are of great importance for development of low cost intensive, eco-friendly and low-input agricultural system, for restoration of natural soil fertility in many developing countries. These areas, which are still underutilized, have potential in development of novel and useful products. It requires the coming together of biologists and physical scientists for innovative product and technology development. ***Thus, it is recommended that there is a need to identify the problems of the industry and promote technology transfer and training of engineers who will fit the wide range of markets,***

***activities, and products that are being encompassed by biotechnology and bioprocess-engineering developments. The synthesis and innovation to develop the enabling technologies for industry by exploitation of the potential of modern biology and chemistry is a significant part of this challenge. Further, industry participations and industry-academia collaboration is required to boost-up OMICS research for development and commercialization of products in agriculture.***

Details about the organization of 'National conference' can be found at the URL [http://cs.gbpuat-tech.ac.in/conference\\_management/node/73](http://cs.gbpuat-tech.ac.in/conference_management/node/73) and detailed report along with photographs of 'National conference' is available on URL <http://www.gbpuat.ac.in/>.

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