First
Annual Convocation

Convocation Address

by

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on

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NAVSARI AGRICULTURAL UNIVERSITY
ERU CHAR RASTA, DANDI ROAD
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His Excellency, the Governor of Gujarat and the Chancellor of the University Shri Nawal Kishore Sharmaji; Hon.'ble Minister of Agriculture, Cooperation, Rural Development, Animal Husbandry and Fisheries, Shri Bhupendrasinhji Chudasama; Hon'ble Vice-Chancellor, Dr. R.P.S Ahlawat, The Faculties, Guests, Media and My Dear Students.

I am delighted to be here this morning, in this young university established in May 2004. More importantly it makes me immensely happy to know that the university caters to the needs of the farmers in the state of Gujarat.

The very purpose with which the Agricultural Universities were established in the country by visionaries like Dr. B. P. Pal, Prof. M. S. Swaminathan and many others was to create a bridge between research, education, extension and the farmers. Modern science specially the application of biotechnological tools based on the frontiers of biology research have enormous potential to improve the agricultural productivity, quality and value addition to the products. Keeping this in view I selected the theme of my address.

Convocation address on 30th December 2005 at Navsari Agricultural University, Gujarat.

This university campus has a special significance, as it is located on the historic road of Dandi March. We recollect the prophetic statement of the Father of the Nation Mahatma Gandhi :

> ***"The earth provides enough to satisfy every man's needs, but not every man's greed"***

My dear students it is for you to always remember these words of wisdom of Mahatma to ensure a sustainable future for the planet earth. Another great human being; a scientist, Nobel laureate Albert Einstein had remarked:

> ***"The concern for man and his destiny must always be the chief interest of all technical effort. Never forget it between your diagrams and equations"***

The messages are very clear – Scientific research is to be harnessed for the welfare of humanity; this must remain the focus of our endeavours.

You are aware that the physical, chemical and biological assets of the earth essentially constitute its capital. One has to be extremely careful in using this capital so as to ensure that no deficit is caused because of unplanned and reckless utilization of the land resources. The resources of the earth are finite therefore its utilization has to be sustainable for

various purposes like agriculture, aforestation, habitations and other human and animal related activities including industrialization.

Introduction

Based on the discoveries and innovations world over, specially in industrialized countries; through the basic understanding and unraveling of the double helix structure of DNA by Watson and Crick in 1953 and thereafter, developing a large number of biotechnological tools and techniques, the field of Biotechnology has assumed a prime position amongst all the disciplines of science – which can address many problems relating to humankind.

Biotechnology can be broadly defined as "using living" organisms or their products for commercial purposes. As such biotechnology has been practiced by human society since the dawn of history in which activities taking place were baking bread, brewing alcoholic beverages or breeding food crops or domestic animals were taking place. These processes actually marked the beginning of what we today call as biotechnology.

The greatest technological break through of the 20th century was the Human Genome Project was completed on April 14, 2003. October 23, 2003 issue of 'Nature' gives the completion of the DNA sequence and analysis of human chromosome 6 com-

prising 167 million base pairs, probably the largest chromosome for which this milestone has been achieved. This chromosome has tremendous significance from the medical research point of view including aspects of protection and treatment for diseases like cancer, schizophrenia, arthritis and diabetes. The most important aspect is a region on the short arm of the chromosome, which encodes the Major Histocompatibility Complex (MHC). It is absolutely essential for the human immune response. This work is going to further light up the curiosity and desire to speed up research in all aspects of genomics.

The challenges, the excitement, curiosity and opportunities are limitless before the scientific community for pursuing modern biology and biotechnology research. Equally important are the aspects of its application. In fact, in the words of Anne Mclaren, past Vice President of the Royal Society, U.K :

> ***"As such, biology is of global relevance and of crucial importance to the future of society. Basic science is driven by curiosity and wonder. Unlike other sciences, there is no sharp distinction between basic and applied research."***

As a result of intensive scientific research and major discoveries over the past four decades especially in molecular biology, biotechnology has emerged as one of the most promising and crucial tool for sustainable development in the present century. Modern biotechnology constitutes a growing range of techniques, procedures and processes. The confluence of classical and modern technologies enables the creation of new products and highly competitive processes in a large number of industrial and agricultural activities as well as in the health sector. This would provide the impulse to radically transform the competitiveness and growth potential for a number of activities and open up new possibilities. In terms of the quality of life we should not underrate the considerable potential of biotechnology for improving the environment by pollution abatement and for improving the healthcare. Biotechnology promises a "golden age" in agricultural production, where no one goes hungry, customized foods contain added nutrients to enhance our health or ward off disease, and farmers produce the raw materials for plant-based industrial stock, fuels, antibiotics and a myriad of other products as well as food.

Agriculture Biotechnology

While delivering the lecture on 'Role of Biotechnologies in Agriculture' in New Delhi on 12 March 2001,

Dr. Norman E. Borlaug, Nobel Laureate said:

"We need the best of biotechnologies, the best of cytogenetics and breeding programme. A package is essential. The new biotechnologies have opened up doors and we should use it to be able to produce food needed by 8.2 billion people in future."

He also said that:

"Good public sector supported programme in biotechnology, linked with genetics and breeding are called for."

Dr. Borlaug commented on the potential of biotechnology and GM food and said that when Mexican wheat was first introduced, many said that it was dangerous. From the beginning, we have been selecting the best plants; then, we learn how to cross the plants; those too were GM organisms but now we can take up gene and put it up in the best variety and get better protection against diseases and insects. It has opened the doors for novel traits. Millions have been eating Bt. corn and oil seeds and there is no indication that it is causing any health problem.

Realizing the benefits of biotechnology, he further said:

"The majority of agricultural scientists, including myself, anticipate great benefits from

biotechnology in the coming decades to help meet our future needs for food and fiber..."

In the past, scientists helped the world avert a Malthusian disaster by improving the genetic characteristics of crops through crossbreeding. Dr. Borlaug and others now conclude that the world has reached the stage where conventional cross-breeding will not be enough. Modern biotechnology will be needed to improve crops sufficiently to meet future food requirements.

Biotechnology provides unique opportunities to increase the quantity, quality and reliability of food supply. These gains can be achieved with potentially less need for pesticides and herbicides, less demand on scarce water supplies and less pressure to use ecologically sensitive land.

To increase agricultural productivity, in an environmentally sustainable manner in the face of diminishing land and water resources – is a highly challenging task. Knowledge based approaches including crop genomics can provide powerful solutions and enhance food security, by improving local agricultural productivity, minimizing the use of chemical inputs such as pesticides and fertilizers, insulating crops against losses from diseases and pests, curtailing post harvest losses including food spoilage, improving food quality and nutrition, increasing crop tolerance to stress factors such as

drought and salinity problem, and through the production of value added products.

We have been domesticating, breeding and hybridising animals and plants since long. But while doing so, we could not accomplish the most desirable goals because of the natural constraints imposed by species barriers and some built-in-limits. Genetic engineering has by passed all the species barrier and information between completely unrelated species in a controlled manner and has given birth to *Precision Breeding.*

Biotechnology can expedite the development of new varieties and also enhance marginal crops like millets, banana, grain legumes, cassava and sweet potato all-important staples in the developing world. Introducing genes that increase by three-fold available iron levels in rice can be a potential remedy for iron deficiency. Biotechnological methods may be used to decrease the time necessary to detect food borne pathogens, toxin and chemical contaminants as well as to increase detection sensitivity. Enzymes, antibodies and microorganisms produced using rDNA techniques are being used to monitor food production systems for quality control. Biotechnology can compress the time frame required to translate fundamental discoveries into applications. Now plants resistant to insect attack like Bt cotton, are a reality, no more the fantasies of science fiction.

A case study compiled by National Centre for Food and Agriculture Policy (NCFAP) reveals that crops (maize, sugar beet and potato) developed through biotechnology can help farmers reap an additional 7.8 billion kgs of yield and improve farm income by 1 billion euros (nearly over 50 billion Rupees) and reduce pesticide usage by almost 10 million kg per year (Global Biotech Science News, June 30, 2003). It is amazing to know that 3 years of field trials of genetically modified cotton in Australia particularly Bollgard II has shown that pesticide use can be reduced by as much as 75% compared with conventional cotton.

In the words of Dr. Gurdev Khush in the Foundation Day Lecture of Trust for Advancement of Agricultural Sciences lecture on "Public-Private Partnership in Agricultural Biotechnology" delivered on October 17, 2005 in New Delhi:

> ***"Genetic engineering or recombinant DNA technology has offered exciting opportunities to introduce cloned genes from unrelated sources into crop varieties for increasing yield potential, disease and insect resistance, tolerance to abiotic stresses and for introducing novel grain quality traits."***

Partnership between academia and industry has become a major vehicle for taking the new

technologies to the farmers' through supply of high quality seeds. We need to focus this area much more in our future endeavours if biotechnology has to make inroads into the agricultural fields.

Many international bodies such as Food and Agriculture Organization (FAO) of the United Nations have recognized the importance of databases regarding the biotechnology information. The genetically modified organisms (GMOs) have been classified into three categories namely, research phase, field trials and commercialization (Status of Research and Application of Crop Biotechnologies in Developing Countries FAO Rome 2005). It is true that most of the commercialized GMOs are being acquired from the developed countries, especially the genes conferring the herbicide and Bt resistance for cotton, maize, soyabean, etc. It is also estimated that very soon the markets in the developing countries may have new GM crops such as virus resistant papaya, sweet potato and cassava; rice with abiotic stress, maize with high lysine content and soyabean with improved oil composition.

A large number of areas need attention where research is relevant for Indian conditions including high quality biofertilizers, biopesticides, molecular markers, immunodiagnostic methods, etc. Genetic engineering can be used to modify the genetic

compositions of plants, animals, and microorganisms. The number of genes that have been isolated and are available for transfer are growing daily. Some of the areas in agriculture where biotechnology has shown significant achievement include:

- Transgenic Crops
- Herbicide Tolerance
- Insect Resistant
- Virus Tolerance
- Other Engineered Products
- Stress Tolerance

Many plants are now being used to produce useful proteins. This has given birth to 'Nutraceuticals' – a word coined for made up food. These foods are also known as functional foods. The nutraceuticals include all 'designer' foods from the vitamin-enriched breakfast cereals to Benecol, a margarine spread that actually lowers LDL cholesterol. A leading American company, Novartis Consumer Health, estimates the US market for functional foods is around ten billion dollars, with an expected annual growth rate of ten per cent.

Vaccine Production from Plants

An interesting development is the use of plants to produce "edible oral vaccines". The plants provide a natural encapsulated environment for the proteinaceous vaccines which can be produced on a very large scale at a cost, which is lower as

compared to using current technologies. Currently edible crops such as bananas and corn are being used for producing a variety of vaccines including vaccines against Hepatitis B, transmissible gastroenteritis and *E. coli* labile toxin.

World over various laboratories have been working on edible vaccines from the plants for various diseases like HIV, hepatitis, etc. To introduce HIV antigen protein gene into tomato is being attempted in U.S. Russian scientists have also started this work; they have taken the help of naturally occurring bacteria to introduce gene (Dr. Shcelkunov's laboratory teamed up with other Russian scientists from both the Novosibirsk Institute of Biological Chemistry and Basic Medicine, and the Siberian Institute of Plant Physiology and Biochemistry in Irkutsk, Russia)

Potential applications of this technology would include efficient immunisation of humans and animals against disease and control of animal pests. For instance, antigens for the Hepatitis B virus have been successfully expressed in tobacco plants and used to immunise mice. This technique promises to pave the way for inexpensive immunisation against several human diseases. Oral vaccines against cholera have already been expressed in plants. Generation of antigens through plants is not only cost-effective, but can also be mass produced, and easily recovered.

Plant biotechnology is stated to be an important R&D business in our country. India is regarded as the largest producer of milk and the second largest for fruits and vegetables. Analysts predict that by 2010 India can become a World's largest exporter of agricultural products.

Agriculture biotechnology has also impacted the health sector not only from the viewpoint of combating the malnutrition but also in preventing and curing some diseases. Scientists at the National Institute of Agro-Biological Sciences in Japan along with a private industry and an institute developed genetically modified rice containing high level of another hormone, the GLP – 1 that promote the release of insulin through Pancreas. Diabetes affects more than 150 million people in the world. We need to find simple affordable solutions to combat this dreadful disease.

Biodiversity

Increased economic growth spurred by genetically improved crops will provide much-needed resources in the efforts to conserve biodiversity. India is one of the world's 12 mega diversity areas, with over 45 000 wild plant species and 77 000 wild animal species registered, accounting for about 6.5 per cent of the world's known wildlife. The biological wealth of India is a valuable asset to be managed prudently, particularly since the CBD recognizes that the

biodiversity present within the political frontiers of a country is the sovereign property of that country. The diversity of living forms in India is the result of climate and soil variability and cultural and ethnic diversity. There are over 53 million tribal people in India, belonging to 550 communities.

There are three mega centres of endemic biodiversity in India – the Western Ghats, the Eastern Himalayas and the Western Himalayas – and 25 micro-endemic centers. We have a rich bioresource base, which can provide novel genes, molecules, enzymes for commercial exploitation, etc. These would eventually generate significant revenue for the state.

The World Summit on Sustainable Development held at Johannesburg during August 26 – September 4, 2002, had reviewed the concept of sustainable development and projected three dimensions as integral part of this, namely:

- Environmental conservation and enhancement of genetic resources;
- Social security of the people and
- Economic security.

Synergy between agriculture and biodiversity and integrating the research strategies for a holistic approach would bring a paradigm shift in agriculture.

Some thoughts for the Navsari University

Vikram Sarabhai, the architect of India's space

programme, a son of soil had said:

> ***"Countries have to provide facilities for its nationals to do front-rank research within the resources which are available. It is equally necessary, having produced the men who can do research, to organize task oriented projects for the nation's practical problems. "***

The above examples are only illustrative to bring home the points that advanced research, especially in an atmosphere of an agricultural university is crucial today to provide the benefits to the farming community. Agricultural universities are privileged to have an infrastructure, which is conducive to the needs of the farmers. Biotechnology being a skill intensive discipline needs high quality trained human resource for its application in the field. Thus a feed back system between the farmers and the agricultural universities needs to be further strengthened.

While biotechnology offers enormous potential to improve the agriculture in a holistic manner, there are immense opportunities for the students, the young scientists who are just joining research and also the faculty members in the university system to plan their career in this field. It can generate employment including entrepreneurship development. A novel

concept is to have in the villages, knowledge centers, which will connect the farmers and the scientists. Krishi Vigyan Kendras were initially established for this purpose. Their scope of activities can be enlarged taking note of the revolutionary developments in information technology. Bioinformatics offers diverse scope to develop the databases for the precision farming and other useful information needed by the farmers. The students in the agricultural universities have a crucial role in transforming the Indian agricultural scenario with new technological inputs. I firmly believe that university system has a very pertinent role to play in a science and technology based development of our nation for the economic and societal progress. If India has to meet the UN Millennium Development Goals through science, technology and innovations,a consistent capacity building is very essential. If 540 million people are still going to bed hungry and nearly 200 million children are malnourished, we can visualize the challenges before us and the stupendous task the agricultural universities face.

We have to create infrastructure, go for a diversity positive recruitment, create and maintain an organizational culture which will attract and retain the best of the male and female students, create a healthy work place and empower women in particular (girl students) to contribute their best in this march of

technological progress. Sustainability of these efforts is yet another crucial factor. Accelerated progress in agricultural biotechnology in harmony with the environment and major initiatives to protect the precious ecosystem which will be offering the humanity a vast gene pool, especially of wild germplasm are called for.

To conclude:

Looking at the enormous potential of biotechnology, it seems apparent that our way of life is likely to be more fundamentally transformed in the next several decades than in the previous one thousand years. By the year 2025, our children and we may be living in a world very different from anything human beings have ever experienced in the past.

The Golden Jubilee of the unraveling of double helix by Watson and Crick was celebrated in 2003. Let us draw the encouragement and inspiration from the monumental work of these two great scientists who gave a new direction and a road map for molecular biology. Look at the optimistic approach. When James Watson was asked about cancer (Newsweek, February 2003), to find a remedy for this is the subject very close to his heart, how quickly can we find a cure he asked? I quote his answer:

"A decade. Most people would say that's much too optimistic. If I owned a big drug company, I'd give myself two years, with a good cash flow. At least we'd be testing in two years. We might be wrong, but it would be worth testing."

Yet the concern for humanity has always been the basis of his scientific research. Dr. James Watson in his famous lecture on 'Gene and Politics' said:

"Genetics as a discipline must thus strive to be the servant of the people"

Are you inspired? Do you want such role models?

My dear students, you are the future of this country. Your education, training and capacity building is the most essential component of our planning for a rapid progress in 21st Century. While excellence is to be nurtured, an all-round growth of your personality to appreciate the concerns of human kind and address them with dedication is very essential. I am sure, the authorities present here are conscious of this need of the country and would certainly recognize the great significance and urgency of the matter – by nurturing the young talents, the universities would move towards attaining the goal of excellence and relevance.

I conclude with the golden words of one of the reatest scientists of this country, Sir C.V. Raman:

"Let us try to make our universities the best – we should not be satisfied with anything less than the best. What will be the result? Instead of a great many of our young men going out of the country, they will remain here and strive to advance our reputation and that will make us strive for more good things"

THANK YOU