THMF. Diagnosis in such cases needs to be confirmed, with the investigative techniques available in modern medicine, so that drugs from different systems of therapy can be compared. The clinical data accumulated by such multicentric trials using 'standardized THMF' will define the indications for a given THMF.

In Ayurveda, some diseases are given specific names and while others are described without specific names. Hence a list of indications for a given THMF does not exist in literature. Ayurveda texts are only the guidelines and much emphasis is laid on the accumulated experience of treating doctors. Evolving the criteria for patient selection, by the process of recording the experiences of Ayurvedic physicians, could answer the basic question of indications for a given THMF. This may also give a new direction to the practice of patient treatment in Ayurveda.

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NEWS

Education in Germany

Germany is one of our key partners in Science, Technology and Education since many decades. There has been good interaction between the scientists, scholars and students in the past. However, there has been no improvement in the situation in the last decade due to various reasons. Germany has studied these reasons and has now come out with measures to attract more foreign students, scientists and scholars for education and research recently.

The German Government has taken a decision to introduce B Tech and M Tech courses in English and are targetting about 20% of foreign students in German Universities in the coming years. Many German universities have introduced special courses and programmes in English like infrastructure, health sciences, public engineering, energy, environment, etc. The German education system has also been restructured to some extent in the pattern that we follow in India, particularly for technical education. There is a distinct advantage in the German system for students as these involve special training and practical applications. I consider that there is a need to popularize the avenues and the new initiatives among our students in India so that they can look up to Germany besides other countries as their destination abroad. The significant avenues for our scientists and scholars are the fellowship programmes and scholarship programmes awarded by Alexander von Humboldt Foundation, German Academic Exchange Service (DAAD), Volkswagen Foundation, Carl-Duisberg Gesellschaft (CDG), etc. While there has been good success rate among the applicants for these prestigious programmes from India, the number of applicants itself is not much. An action plan to enthuse our scientists and scholars for responding to these programmes is essential.

The schemes mentioned above while attracting the Indian scholars, scientists and students expect them to return to India after their education or training or research experience. This is a very positive point for India in developing a strong base of highly qualified and trained personnel for the country.

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Genetically modified organisms in agriculture: A risk-aversion package

During 1998, nearly 12 million hectares were under transgenic crops with most of the area covered by genetically modified (GMO) soybean, maize, cotton and canola (mustard). Nearly 75% of the area under GMOs was in the USA where the regulatory measures in force seem to ensure that the public have confidence in the environmental and nutritional safety of GMOs. This is not the case in India as well as in European Union countries. A group of experts constituted by the Royal Society of London to go into this question have concluded that consumer confidence, based on an appreciation of the scientific evidence and the regulatory checks and balances, will ultimately decide whether or not GMOs will make a significant contribution to feeding the world's rapidly expanding population (*Genetically Modified Plants for Food Use*, The Royal Society, London, September 1998, p. 16).

India's agricultural strategy for the 21st century will have to place emphasis on producing more per unit of land,

water, energy, time, capital and labour, though pathways that will ensure that the productivity improvement is not associated with long term ecological and/or social harm. Also agriculture has to be a key instrument for producing not only more food but also more income and jobs. It is in this context that the new opportunities opened up by genomics and molecular breeding for fostering sustainable advances in crop and farm animal productivity and quality will have to be assessed carefully for their benefits and risks.

Research carried out with the new genetic technologies during the last 15 years has shown that they can help to improve crops in more precise and faster ways as compared to the traditional Mendelian methods. Designer crops based on novel genetic combinations created by moving genes across sexual barriers are now becoming available. Opportunities for breeding varieties for resistance/tolerance to biotic and abiotic stresses and drought and salinity tolerance as well as for improved nutritional qualities are particularly important for farming families struggling to improve yields and quality under unfavourable growing conditions. It is such opportunities that are leading to increasing investment in agricultural biotechnology by both the public and private sectors in India. While industrial countries are making greater investments in medical biotechnology as a result of their priority for better health security, India's emphasis has been more on agricultural biotechnology because of the need to ensure food and nutrition security for current and future populations.

While the benefits are attractive, recombinant DNA technologies resulting in genetically modified organisms (GMOs) have also aroused widespread public concern in several respects, some of which are the following:

- Direct effects of the transferred genes on the recipient organism(s).
- New possibilities for unfavourable recombinations.
- Behaviour of the GMOs in field situations.
- Effects on environment and biodiversity.
- Nutritive properties of the food produced by GMOs.

In addition, the impact of new technologies such as 'gene protection technology' and the growing expansion of proprietary science on small and resource-poor farming families who save seeds to raise crops, needs careful consideration and monitoring.

India has one of the world's largest public sector plant breeding enterprises functioning under the overall umbrella of the Indian Council of Agricultural Research. Regulatory mechanisms for field testing of GMOs exist, based on the guidelines issued by the Department of Biotechnology and the Ministry of Environment and Forests of the Government of India. The existing regulatory mechanisms however seem to be inadequate for instilling the requisite degree of public and media confidence in relation to bioethics and biosafety. Therefore, no further time should be lost in introducing an integrated precautionary package which will help the country to derive benefits from genomics and molecular breeding of crops and farm animals without associated environmental, social and health risks.

On the occasion of the Indian Science Congress, a National Consultation on GMOs was held at MSSRF, Chennai on 6 and 7 January 1999 on the topic 'Genetically Modified Plants: Implications for Environment and Food Security and Human Nutrition'. The participants made several suggestions for intensifying the use of biotechnology for the public good. Some of these are:

- Promoting greater interaction between public and private sector scientists, civil society organizations, the media and the judiciary and organization of interactive workshops for this purpose.
- Information empowerment and education at all levels, starting with the village panchayats.
- Integration of GMOs within an integrated natural resources conservation and enhancement strategy, such as including GMOs in the context of an IPM framework in the case of pest management.
- Increasing the national capacity in assessing known and unforeseen risks and in developing an unbiased balance sheet of risks and benefits.
- Intensification of research in the public sector and expanding meaningful public–private sector partnerships.
- Strengthening the infrastructure for research on micro-organisms as well as farm animals, including fish.
- Introducing special demonstration, training, credit and extension programmes to take the benefits of transgenics to the economically under-privileged farming families.
- Developing coordinating and educational mechanisms at the national, state and panchayat levels which will inspire public confidence and public acceptance of GMOs.
- Promoting a knowledge system for sustainable food security based on the integration of traditional and new technologies.
- Fostering greater international cooperation based on national priorities and interests.

Based on the above, the following institutional structures are suggested at the level of official regulatory and oversight mechanisms.

(i) Set up at the Government of India level a National Commission on Genetic Modification of Crop Plants and Farm Animals as an apex level coordinating and policy oversight body with its jurisdiction extending to all areas of agriculture, i.e. crop and animal husbandry, fisheries, forestry and agro-processing. The composition of such a Commission could be as follows.

- An independent chairperson with high professional competence and public credibility.
- 20 other members representing the scientific and academic community, private sector R&D, civil society organizations, senior representatives of the Ministry of Environment and Forests, the Union Planning Commission, DBT, ICAR, CSIR, ICMR, ICSSR, DST, Department of Atomic Energy and Ministries of Agriculture, Commerce and Industry, the National Commission for Women, the mass media and a few representatives of State Governments, State Agricultural Universities and Panchayati Raj institutions.

(ii) Entrust the National Commission with the responsibility of coordinating and enforcing a Precautionary Package for the safe and beneficial use of GMOs comprising the following major components.
- Bioethics: Ethical codes for experimentation and field testing.
- Biosafety: National and international protocols.
- Biosurveillance: Policies for introduction of technologies (e.g. 'terminator') and assessment of environmental and social impact.
- Food safety: Toxic or allergenic effects as well as wholesomeness.
- Consumer choice: Compulsory labelling.
- Public information: Transparency, information empowerment.

The National Commission on GMOs may establish four standing committees, each chaired by an appropriate commission member to pay speedy and integrated attention to issues such as the following:
- Bioethics and biosurveillance.
- Biosafety (national guidelines and international protocol under CBD).
- Biodiversity and food safety.
- Public education, understanding and participation.

This proposed National Commission on GMOs should have an autonomous status and can be serviced either by the Ministry of Environment and Forests or DBT or ICAR. Since the role of the National Commission is not limited only to biosafety issues, its small professional secretariat, though linked for budgetary purposes to an existing Ministry or Department should have complete autonomy coupled with accountability. The Commission, for this purpose, should be a statutory body.

The Government of India has already in place a 3-tier regulatory structure for ensuring the safe-handling of GMOs. The proposed National Commission is designed *to streamline and strengthen and not to supplant* ongoing activities. The present regulatory structures will all report to the National Commission on GMOs, which will provide overall policy guidance and oversight, within the framework of the National Environment Protection Act.

The National Commission on GMOs should prepare an annual report on the work done during the year in the country and present it to Parliament.

(iii) State Governments may set up similar bodies at the State level in order to provide a channel for the speedy and effective implementation of approved protocols, regulations and guidelines. The State level Genetic Engineering Board should not only have regulatory functions but also promotional and educational functions, including the sponsorship of Biotechnology Parks for providing opportunities to young men and women for remunerative self-employment. The State Boards can prepare an annual report for being placed before the respective State Legislatures.

(iv) At the village level, Panchayat Biotechnology Committees may be set up to monitor field experiments with GMOs and assess their impact on the economic well being of rural families and on the ecological health of the area.

Thus, an organizational structure which extends from the village to the national capital will help not only to promote public understanding of the opportunities and implications of the emerging biological century, but also to allay public fears and apprehensions.

While the above institutional structures are important at the governmental level, every research institution and commercial company, whether public or private, should have its own voluntary code of conduct based on the recommendations of their inhouse Bioethics and Biosafety Committees. Government laws, self-regulation, education and public understanding will all be necessary to ensure that genomics and molecular breeding become powerful instruments for building an environmentally and socially sustainable food security system.

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RESEARCH NEWS

Telomere dynamism and developmental connection of differential telomerase activation in cell proliferation and replicative senescence

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Role of telomere erosion in cell ageing and its prevention by forcing the expression of telomerase is of topical interest[1–5]. Axiomatically, the various cell types in eukaryotic organisms maintain a differential but dynamic control of such regulation *in situ* – a precise knowledge of which has value to underpin growth and differentiation for prospective utilization.

Telomeres are specialized essential elements at chromosome ends of eukaryotic chromosomes (Figure 1) that remain associated with the nuclear matrix in the interphase nuclear organization[6,7] and facilitate separation of chromosomes at anaphase[8]. They are thought to function as buffers against end-to-end chromosome fusion and protection from exonuclease degradation[9–11]. Telomeres of most eukaryotes