Biotechnology, like Information Technology is advancing at an incredible pace. We, in Bangladesh, have not kept pace with this important global trend. In fact we have not paid any attention to this vital sector that may hold the key to our future development.

To focus national attention on this all important sector, The Daily Star and the Biochemical Society of Bangladesh are jointly organising a Symposium and a Roundtable today at the Dhaka University to chalk out ways in which Bangladesh can benefit from this new and exciting science. We believe that with government and private sector support scientists of our country can achieve significant breakthrough in this field.

For Economic Development of Bangladesh

Promoting Science Education in the Area of Biotechnology is the Dire Necessity

by Professor Ahmad S. Islam

Micropropagation of ornamental, medicinal, timber, forest and fruit plants through tissue culture is the easiest of all biotechnological tools to multiply elite plants en masse and at the same time preserve their qualities

THE phenomenal advancement of different branches of biotechnology is breathtaking. Unless developing countries such as Bangladesh take immediate steps to keep abreast with its astounding progress, they will be left behind without having a second chance to recover from the great loss that may accrue from their ignorance of its great multi-faceted benefits.

Multinational companies which are multiplying in an ever increasing number will take advantage of this situation and will try their best to monopolize their trade in the developing countries. This will further contribute to deterioration of the economic conditions of the three-fourths of the world's total population which is now reaching a staggering figure of nearly six billions.

Micropropagation industry has not developed in Islamic countries although it is the easiest of all biotechnological tools to apply.

Micropropagation of ornamental, medicinal, timber, forest and fruit plants through tissue culture is the easiest of all biotechnological tools to multiply elite plants *en masse* and at the same time preserve their qualities. Except air conditioned rooms to grow plant material, tissue culture laboratories do not require sophisticated instruments, expensive chemicals and huge running costs and at the same time bring huge profit after the micropropagation technique for a particular material is set and the cycle is put into operation. The breakeven time is about two years. Besides, the tissue culture derived materials are uniform in their plant characteristics and growth and free from any diseases. Another great advantage is that propagation can be carried out throughout the year. In India, Thailand, Singapore, Sri Lanka and many other Asian and European countries, this is a flourishing and very profitable business and some companies are exporting their material to overseas. However, one of the stumbling blocks towards establishing an industry for micropropagation is that sometimes without warning, the whole batch of tissue culture material gets contaminated and is to be thrown away much to the disappointment of the investor. However, after such an initial setback, almost all companies recover from their losses.

In spite of the bright prospects of this industry, it has not yet established itself firmly in Islamic countries. One of the reasons may be that investors want quick return on their money. In Bangladesh, some six companies have been recently established but their performance has not come up so far to the mark. These companies missed a big opportunity to make huge profits; they did not have enough stocks of banana suckers to supply to banana growers who lost almost all their plantations during and in the wake of the recent unprecedented flood. Orchards could be produced in some of the Islamic countries not only to meet home consumption but also to export it. The trouble with the investors in the third world countries is that almost all of them want to invest money in business which will ensure profit in the minimum possible time.

A very large volume of good quality plant material called 'elite' are in great demand in Islamic countries and yet industries for supply of such material have not developed. For instance, the arid regions of Middle East and sub-Saharan Islamic countries require quality saplings of "neem" (Azadirachta indica) in very large numbers; in the last twenty years or so this plant species has proven itself to be suitable for plantation in semi-arid regions, for checking erosion and halting the process which turns arable land to desert. From time to time, Bangladesh receives request from Middle Eastern countries and from Australia to supply them "neem" saplings but due to absence of big commercial laboratories and other paraphernalia to handle orders of this kind, their requests could not be complied with. Basic research in this field is necessary because protocol for production of model "neem" plants needs further improvement both to assure uniform saplings and a comfortable margin of profit.

One of the Advanced Research Centres which falls into this category is, "The Unit for Advanced Propagation Systems," at Wye College, University of London. This centre was established 15 years ago and has already trained many scientists both from developed and developing countries including a number of scientists from Bangladesh. They have recently developed the protocol for micro-propagation of date palm. Since date palm is the number one crop in the semiarid zones of Middle East countries and Africa, it will be a good idea to profit from their experience and apply this technology to grow quality date palm trees by raising millions of saplings through micro-propagation.

IAS may suggest to COMSTECH and ISESCO to collect data and make a feasibility study on the cost-effectiveness of micropropagation of "neem" and date palm and other materials to be selected for micropropagation for various regions constituting different ecological zones. Scientists from Bangladesh, Malaysia, Pakistan, Saudi Arabia, Egypt and Indonesia may be selected to form a committee giving it the necessary mandate to prepare a project and submit it to the above organization(s) for scrutiny. Once the project takes final shape, the Islamic Developmental Bank may be requested to examine it and finance it depending upon its appropriateness. From the experience based on my visiting several companies of this kind in India and Nepal I have no reservation to comment that given teething period of a couple of years, it will be a profitable concern both to the investors and the countries needing elite seedlings of various plant material. We may request the Netherland Government to help us build this industry. Fortunately for us, one of the Directors of an International Horticultural Organization at the Hague is Dr. Motlubor Rahman, a well-known horticultural scientist from Bangladesh. He would certainly help us if we make this move.

Why should the developing countries be concerned about the fast development of this sector of science?

The reason is obvious. In the majority of Muslim countries, food deficit is a chronic problem along with health hazard. As a result, quite a sizable chunk of the budget of Islamic countries go to importing grain crops and cereals to feed their hungry people. The money could have been diverted to the nation-building activities if the import of food could be stopped through adoption of new technology such as that advocated by MONSANTO, one of the largest multinational companies.

Change of Strategy: Multinational companies have been making relentless effort to capture gradually the grain, vegetable, fruit and flower markets of developing countries. These companies have produced genetically modified crops, animals, fish in which either the resistance to different diseases or pests or new desirable traits or marker genes etc., from other species have been incorporated; or in case of animals, genes for increased milk or therapeutic protein production have been introduced. According to a recent statistics the following genetically modified crops have been produced within the last 12 months.

Herbicidal resistance	1486
Insect resistance	1237
Bacterial genes	68
Product quality	1030
Nematode resistance	874
Fungal resistance	345
Agronomic property -	257
Other	175
Marker genes	142

Because the genetically modified crops (GM), have better characteristics with an enhanced yield contributed by built-in immunity to insect and pest attack, they have already created a great impact in both developed and developing countries. If it meant buying good quality seeds only one time, it would not have posed so great a problem in spite of the grossly exaggerated prices of the imported transgenic material. What these companies do is that they insert a 'terminator gene' in the varieties they release in the market. Crops of such varieties give a very good yield but their seeds are unable to germinate. In other words, farmers cannot save their seeds; for every season, growers must buy their seeds from a particular company.

Hybrid Rice: A case in point is the hybrid rice variety released recently by MONSANTO. This company was about to strike a long term deal with the "Grameen Bank" of Bangladesh on supply of genetically engineered hybrid rice with enhanced yield. If this deal had materialized, it would have caused a great harm to Bangladesh on two accounts. First the farmers would have been forced to buy rice seeds every year at the dictated price of the above multinational company and secondly, the rice breeders of Bangladesh would have been deprived of their intellectual property rights even if, at a later date, they came up with a high yielding transgenic rice. It may be mentioned that for quite sometime scientists of Bangladesh Rice Research Institute have been trying to breed such a variety in cooperation with their counterparts in the International Rice Research Institute.

Transgenic Aspen: Seven new lines of transgenic hybrid poplar trees (Populus sieboldii x P. grandidentata) developed by Nippon Paper Company of Japan are now being experimented upon by the Plant Pathology and Forestry Department of the National Oak Ridge Laboratory and Tennessee University in the United States. These are resistant to crown gall disease caused by Agrobacterium tumefaciens. The other interesting fact about these transgenic lines is that they were produced by transformation with A. tumefaciens. The disease organism itself was used to bring in the genes conferring resistance.

Transgenic Eucalyptus for Plantation Forestry: Transgenic Eucalyptus(Eucalyptus camaldulensis) plants have been developed in the CSIRO Lab., Australia. This strain contains a gene that produces insecticidal protein and in bioassays this strain was shown to be toxic to the larvae of three Chrysomellid beetles (Chrysoptharta species) that can be serious pests in eucalyptus plantation. This strain is also active against the broad-spectrum insecticidal gene herbicide Basta (glufosinate ammonium). Transgenic trees were grown in a containment glasshouse. The same plants sprayed with commercial formulations of Basta showed no symptoms of damage at levels that completely killed non-transgenic plants and that would kill many of the problem weeds in plantations. These experimental results verify the potential for using gene technology to improve production of eucalyptus for the pulp and paper industry and the scientists are now trying to transfer the technology to species such as E. nitens and E. globulus that are more economically useful in Australia.

Transgenic Sweet Potato, Peanut, Cow Pea and Muskmelon: Transgenic varieties of the above crops have been successfully produced at the Centre of Plant Biotechnology Research Centre at Tuskegee University, USA. The University encourages participation by scientists from outside the United States. This being the situation, some universities from Islamic countries may embark upon a joint project with them. Indeed, if the gene(s) conditioning disease resistance capacity can be introduced in the above crops, it will be a great leap to meet the challenge of food shortage in some of the Islamic countries where famine and flood are regular occurrences depending upon their geographical locations.

Genetically Engineered Alfalfa: The strain of this genetically engineered alfalfa produces an industrially valuable enzyme phytase. This enzyme acts in a way that eliminates the use of phosphorus supplements in poultry food thereby reducing environmental pollution to some extent.

The Transgenic Fish: The Somatotropin gene has been inserted from rainbow trout to catfish, salmon, carp, goldfish and tilapia. The transgenic carp was found to grow 20-40 per cent faster than normal. The gene in winter flounder fish responsible to prevent ice formation in the skin of the fish, has been isolated and introduced into a bacterium. Some reporter genes such as GFP (green fluorescent protein), lac Z and CAT have been used successfully to replace antibiotic resistance genes as markers. The use of the new reporter genes will make the transgenic fish harmless and therefore will be more acceptable to consumers. Use of the above reporter genes has another advantage, namely, it reduces the frequency of genetic mosaic.

Sockeye salmon histone H3, metallothionei-B and antifreeze protein genes have been successfully used to drive expression of introduced genes. Regulatory sequences from Carp beta-actin constituting promoter/enhancer have been found to drive expression of the genes of interest.

Amendment of Soil by Means of Engineered Microbes: In drought prone countries which characterize many Islamic countries, arable land turns into uncultivable soil gradually, not being able to support any crop. But in the future, thanks to the pioneer work being carried out at National Oak Ridge Laboratory and the University of Tennessee, genetically engineered microbes GEMs would be available soon to amend these soils where practically nothing grows now. GEMs have been produced to degrade polyaromatic hydrocarbons. Research in this area should be initiated not only for amelioration of soil but also genetically modified microbes capable of degrading animal feces to the fullest extent possible for generation of biogas. At present the feces of two cattle head is necessary to run a biogas plant in an individual household but not many have the means to maintain two animals.

The author is President, Bangladesh Association for Plant Tissue Culture

GE Seeds: Saviours or Terminators?

by Bakhtiar Rana

Genetically engineered seeds may have proved fabulous to grow more crops and food. But critics denounce the technology as a tool to kill small farmers.

WHO would not love to have a farm as big as the Carter family's that yields legion benefits? Jimmy Carter is an advocate of genetic engineering. By increasing crop yields, he says, genetically modified organisms reduce the constant need to clear more land for growing food.

"Seeds designed to resist drought and pests are especially useful in tropical countries, where crop losses are often severe," says Carter, who governed America as its 39th President from 1977 to 1981. For centuries, farmers have improved plants through selective breeding within species and hybridisation. Through genetic engineering, genes can be extracted from one species and inserted into another, producing "transgenic" varieties. Traditional plant breeding involves more time and the crossing of hundreds of genes. With genetic engineering, researchers can transfer only one or a few genes of interest involving animals to plants.

Monsanto, a US-based agrochemical company, says one of its major developments has been the production of genetically modified crop seeds with conferred herbicide resistance and bio-insecticide ability.

To genetically engineer products, it uses the method of Ballistic Impregnation. The process involves sticking the DNA to be introduced onto minute gold or tungsten particles. The particles are fired (like bullets) into plant tissue with a gene gun. A proportion of the plant cells treated this way take up the DNA from the metal pellets. Whole plants are then regrown from the cells by tissue culture. Critics say crops are being genetically crossed with bacteria, viruses and petunias to withstand applications of herbicides so giant companies like Monsanto can increase their chemical sales.

Herbicide resistance among weeds and wild relatives of crop plants from genetic pollution is a threat posed by these manipulated crops, threatening ecosystems, consumer health, and ultimately the domestic farm economy. Gene manipulation has developed over the last 20 years as a new field of biotechnology. It is now a multi-million dollar global business with proponents claiming it will increase food security and alleviate world hunger.

Opponents feel it will lead to disempowerment of small farmers and make them prisoners of major seed producing companies. They argue that GE is not the solution to food security problems caused by, not lack of food, but factors like lack of purchasing power and failures of distribution. In an article, "Who's Afraid of Genetic Engineering?", published The Daily Star, Carter says, GE cotton, corn and soybean seeds became available in the US in 1996. "This growing season, more than one-third of American-soybeans and one-fourth of our corn will be genetically modified."

In 1997, the use of GE seeds in commercial farmlands worldwide grew 10 times more than the year before. In America, 3.5 million hectares of GE soya were planted in 1998. Monsanto expects 1.4 million hectares of GE soya to be grown in Argentina in 1998. Greenpeace USA reported American cotton farmers planted 170,000 acres with Monsanto seeds in 1996, but in some fields up to 60 per cent of the plants were destroyed by caterpillars. Almost 20,000 acres of cotton worth one billion US dollar was lost in Texas.

Reports from London say Europeans are eschewing genetically modified crops as they prefer practices developed over centuries to the prospect of a future in which nature has somehow been modified. The capacity of American and European farmers to act and react to a new technology that involves risks and "dangers" is not even a day-dream to the poor cultivators of South Asian countries, like Bangladesh.

Experience with hybrid crops has been disastrous in India. Farmers reportedly committed suicide after failed harvests left them financially ruined. New Delhi is now seeking to bar imports of GE seeds containing a "terminator" gene that self-destructs and renders seeds sterile. Proponents of sustainable development feared the worst when the micro-credit institution, Grameen Bank, announced on June 25 this year a partnership with Monsanto. Imagine a situation in which subsistent farmers face a failed harvest after borrowing high-interest microcredits from Grameen to pay for Monsanto seeds, herbicides, royalties and technology fees.

And they are under constant pressure to keep GB's recovery rate up. Grameen, however, pulled out of its joint venture project with Monsanto to commercialise GE crops in South Asia on July 28 in the face of an electronic protest campaign by environmentalists who said it could threaten the livelihood of hundreds of thousands of farmers. "... there is significant opposition to genetically engineered Monsanto crops in the US and Europe," said a message to "South Asian allies," expressing surprise over GB's partnership with Monsanto. Many well-known individuals and institutions, who were baffled by Bangladesh's famed economist and GB's founder-managing director Prof. Muhammad Yunus' sudden tilt to genetic engineering, hailed his reversal decision. Monsanto, on March 3 this year, took over Delta and Pine Land Co. that had developed the seed-sterilizing technology, leaving farmers with sterile seeds they cannot replant.

The Rural Advancement Foundation International (RAFI) has dubbed it the "terminator technology" and started a worldwide campaign to urge the US Department of Agriculture not to license this "potentially lethal technology."

A declaration of the Convention on Biological Diversity in May this year warned of the implications of this technology. Environmental scientists said if the "terminator wheat seed" is planted next to a farm with natural wheat, it could pollute the field and adjoining fields. They say transgenic crops themselves might become weeds. Besides, a major ecological risk is that large-scale releases of transgenic crops may promote transfer of transgenes from crops to other plants which may then become weeds.

They could be carried by air and cargo.

According to a Greenpeace International estimate, up to 1.4 billion resource-poor farmers in the South depend on farm-saved seeds and seeds exchanged with farm neighbours as their primary seed source.

It observes that a technology that threatens to extinguish farmer expertise in selecting seed and developing locally-adapted strains is a threat to food security and agricultural biodiversity, especially for the poor.

Owners of the "terminator" patent have indicated that they will apply for patents in 87 countries. The patent is pending at the European Patent Office, in Canada, Australia, Japan and South Africa. "Biotechnology has both benefits and dangers... Don't reject it. You can use it with caution," says the World Bank's outgoing country director in Bangladesh, Pierre Landel-Mills.

While he essentially reflects the World Bank's views, his homeland, the UK, presents a different scenario. Press reports say vandalism has become so common at sites in Britain, where GE crops are tested, that the government is considering 'concealing' their locations. More than 12.1 million hectares of commercial farmland were planted with GE seeds worldwide in 1997 but none of them were in the 15 countries of the European Union.

Norway no longer accepts US soyabean imports while Austria and Luxembourg have totally banned genetically modified food. The herbicide resistant plant accumulates in its tissue the used herbicide which goes into the final product (foodstuff) causing a threat to consumer health. In France, a citizens' conference produced an ambiguous statement of "cautious" support for such crops. French experts view the use of genetically modified organisms in food and agriculture as highly polemical.

Landel-Mills, who sometimes sounds a pro-Bangladeshi intellectual and hopes to see Bangladesh become a middle income country (by pursuing pragmatic policies) by 2025, appears critical of the "terminator" technology. "This is bad," he says. Critics say the dominant focus of research in GE undertaken by chemical multinationals is not on fertilizer and pest-free crops, but pesticide and herbicide resistant varieties.

Such companies have the pressure to maximise their returns on investment by maximising their market shares. Monocultures, according to critics, are ecologically unstable and that reason alone should be enough not to view them as essential to production. The Union of Concerned Scientists found that in 93 per cent of the cases it studied, the real goal of genetic food alterations is maximising profits from industrial-scale food production and processing.

According to Panos Institute of London, Monsanto is the world's second largest agrochemical company, with a total 1996 revenues of USD 9.26 billion. It has launched a USD 1.6 billion advertising campaign in Europe to win public support for GE food and crops. It is also seeking to win acceptance in Africa and other countries of the South. African leaders and eminent persons have been asked to support Monsanto's campaign that the world's poor need GE crops.

In a counter move, some African scientists have strongly objected to the attempt to "push" the "terminator" or other gene technologies that will destroy the sustainable agricultural systems the farmers have developed for millennia.

They believe that western science can help improve agricultural production but it should be aimed at addressing the real needs of the people, rather than serving to swell the pockets and control of giant industrial companies. They have just ventilated the sentiments of many agricultural experts of the South. — *News Network*

The writer is a News Editor of UNB and general secretary of the Forum of Environmental Journalists of Bangladesh (FEJB).

Mammals Cloning Technology

by Abdul Ahad and S. K. Zahan

THE scope of future basic biological research has been increased by the success of cloning in cattle, an important species in agriculture, biotechnology, and human medicine. For example, mammals possess a set of so-called imprinted genes that are expressed depending on which parent they are inherited from. Both paternally and maternally imprinted genes are necessary for normal development. Now, using nuclear transfer of a differentiated cell derived from an adult, scientists can determine whether imprinting is preserved or erased in differentiated cells. Dolly, the first animal cloned from an adult mammal, was produced by somatic cell nuclear transfer from a cell population derived from mammary tissue taken from a 6-year old Finn Dorset ewe. These results were culminating in a letter by Sgaramella and Zinder and suggested that Dolly might actually have been cloned from a fetal cell that had contaminated the udder-cell culture through a biological or laboratory accident. But recent molecular analysis of DNA from Dolly showed that she contained the same seven microsatellite colls as those present in the cell population from which she was derived.

The recent birth of three generations of cloned mice from an adult somatic cell by scientists at the University of Hawaii (Honolulu) suggest that cloning or nuclear transfer and reprogramming of mammalian cells, are both possible and reproducible in species other than sheep. Although mice cloning had been thought to be nearly impossible due to fragility of their oocytes. Hawaiian team leader Ryuzo Yanagimachi also reported that still the rate of success using nuclear transfer to produce offsprings is 1-2 per cent, about double that of Ian Wilmut's team when his team created Dolly the sheep. This improvement may be due to using microinjection instead of electrofusion of the donor nucleaus to the recipient egg. The choice is of donor cells that are normally arrested in G0 phase of the cell cycle instead of using a cell population that has to be induced to arrest in G0 in vitro, and waiting three to six hours before activating the newly created couplets.

With the cloning of large farm animals, we can try to set some near and distant goals which become economic. The profit motive has, fortunately, kept cloning research alive, despite initial difficulties. Genetically altered fibroblasts (connective tissue cells) can now be used to clone cows by nuclear transfer, and this should allow us to engineer the large-scale production of useful proteins by farm animals. Obiviously, culturted cells must be used for precise targetting of the desired genetic manipulation, be it the addition or deletion of a specific gene. This again highlights the need to establish well-defined, cultured cell lines to be used for cloning.

Few months ago one of the Japanese groups also cloned calves (and its subsequent death) at Kinki University in collaboration with Ishikawa Prefectural Livestock Research Centre. Japanese Science Council, an advisory panel of the Ministry of Education , Science, Sports and Culture (Mombusho), has taken its first step towards introducing a ban on human cloning. According to the council's latest report research involving the cloning of humans is 'ethically unacceptable'. Regulations will be introduced to alleviate concern among the general public over cloning techniques, which has grown in the wake of the recent births. The application of techniques such as somatic cell nuclear transfer to nonhuman cells and all cloning projects will undergo careful assessment by a committee of experts in ethics, medicine and the law.

Finally, what about cloning humans? Since we are humans, and self-awareness does not appear to be an automatic faculty of our species, we need to ask question what is a human, who created us and why — just sort of questions that irritate many, frustrate the technologists, enrich the philosophers. Most of us don't know the answer, but we know something that, for our practical purpose, is better than the answer. We know what a human does and wants. We have not studied what precisely it is we want to achieve and we will be in no real position to clone anything humanly worthwhile until we have done that intense and unprecedented work. At some point we will have to determine whether and when cloning — in the type of taking somebody's cell nucleus, transferring it into an egg and raising the embryo to term and beyond should be attemped. But we must remember that cloning is not an instant duplication, so mad dictators will not be able to expand themselves into huge armies of double (look alike), nor will the bereaved be able to restore their lost ones. There is nevertheless, one area in which cloning technology can be useful to humans: cell and tissue therapy.

The writers would like to emphasise that its an appropriate time to think very clearly and carefully about what we are, and what we want us to be. This life and next life! Who is it, what is it, that we want to clone? Treat gently — we are on sacred ground. Vagueness here will certainly be the death of us.

Both the writers are doing their higher research on cellular and molecular biology at the University of Freiburg, Germany.