These five companies were ABB, Midland Power, AES Power, Marubeni and Genting. In this connection, a pre-bid meeting on the Meghnaghat Power Plan project was held at the BPDB office on April 28, 1997. The first such meeting with private power companies was conducted by the BPDB Chairman.

(Extracted by Dr. Sabir Majumder from The Daily Star, via Internet)

Private Fertilizer Plant Soon

The Bangladesh Shilpa Rin Sangstha (BSRS) along with other banks and DFIs will provide financial support to the tune of Tk 220 million to Bangladesh Fertilizer and Agro-Chemicals Ltd. The first and biggest Indo-Bangla joint venture fertilizer factory is to be set up in the private sector.

(Extracted by Dr. Sabir A. Majumder from The Financial Express)

Solar Power Generation Starts

NARSINGDI, June 26: Bangladesh entered into a new era in the power sector today when solar power generation was commercially started in an island near here. Energy and Mineral Resources Minister Lt. Gen. (Retd) Mohammad Nooruddin Khan inaugurated the "solar Photovoltaic Pilot Project" in the Island comprising Karimpur and Nazarpur unions under Narsingdi district at a simple function held at the Karimpur High School ground. (BSS)

(Extracted byDr. Sabir A. Majumder from Internet)

SURVEY RESULTS

Continued from page 4

more publicity per year as those against it. A few members felt the extent of publicity should remain the same.

Section G: Personal Commitments

Most of the members surveyed refrained from answering if they were willing to serve actively in BCBSNA. Of those who responded, a little over half (8/14) indicated that they were not able to serve on any committee at the present time. The members (6/14) who replied in the affirmative wanted to participate actively in such areas as job counseling, fund raising, and sending instruments to Bangladesh. The majority of members (16/22) who replied indicated that they do receive scientific journals or magazines, and are interested in donating such publications to Bangladeshi institutions, and that they would be interested in collecting and donating analytical instruments for departments of colleges and universities in Bangladesh.

The BCBSNA Executive Committee is grateful to Dr. Bhajendra Barman for his time and efforts in developing the survey form and is thankful to all the members who responded to the survey. Implementing the results from this survey will help build an even better, stronger BCBSNA.

Dr. Abu Shamsul Huq

A Correction

In the March 1997 issue of the BCBSNA Newsletter, the Bangladesh Chemical Society President's name was printed as "Dr. M. Shafiqur Rahman". The correct name is "Dr. Shafiqur Rahman". We apologize for the inadvertent mistake.

ARTICLES

Genetic Engineering of Jute - A TOKTEN Initiated Project

Dr. Rafiqul Islam Khan, Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota

Our prides and emotions go high when we think of our 'Golden fiber of Bengal'. It used to be the backbone of the economy of the then Pakistan comprised of East and West wings, by earning the highest foreign exchange for the country. Unfortunately, with the development of synthetic fibers, jute (a natural fiber) has gradually become out of favor with the consumers. In the world market, jute price is always controlled by the foreign buyers (not farmers or sellers) and it remains unpredictable and unexpectedly low. Jute farmers have gradually become frustrated because in most years they can hardly recover their cost of production. Research on the development of high yielding jute varieties and better use of jute fiber are yet to make breakthroughs. Had it been a crop of the developed countries, appropriate research especially genetic engineering approach could be in place for development of better varieties and better fibers.

Genetic engineering technique has emerged as a powerful tool for improving crop varieties by the introduction of foreign genes of interest. Developed countries are increasingly applying this technique to develop genetically engineered crops with their desired genetic changes especially when that character of interest is not available in the crop varieties. In this regard, jute appears to be an ideal crop for application of genetic engineering techniques because of the low genetic variability among the germplasm and difficulties involved in developing better varieties through conventional breeding techniques. Therefore, if an appropriate genetic engineering technique for jute is developed, useful genes of interest may then be incorporated to make better varieties of jute.

I became involved with the initiative of developing a genetic engineering technique for jute in December, 1993. The process was initiated in May, 1993, when I as a molecular biologist of the CSIRO (Commonwealth Scientific and Industrial Research Organization), Australia, visited Dhaka University and BCSIR and presented seminars on my work on development of genetically engineered clover plants with disease resistance and better nutritional properties enabling an increased wool production of grazing sheep (Khan *et al.* 1994 and 1996). Dr. Serajul Islam of the Bangladesh Atomic Energy Commission (BAEC) came forward and asked me if I could help the BAEC in initiating work on genetic transformation of jute. The name of the TOKTEN (Transfer of Knowledge Through Expatriate Nationals) surfaced as the probable funding source. I found it to be a wonderful opportunity to pay my debt to my country, and to meet my relatives and friends in Bangladesh. The TOKTEN program is funded by the UNDP to help developing countries to regain help from their scholars emigrated to developed countries. This program in Bangla-

desh is administered by the External Resources Division (ERD) of the Bangladesh Government for evaluation of the program and subsequent forwarding of the approved cases to UNDP. Shortly after the meeting with BAEC, we submitted a joint application to ERD for TOKTEN assistance to initiate work on developing a genetic engineering technique for jute. Our research project was approved by both ERD and UNDP. At that moment we were in need of some genes and chemicals to start the project at BAEC. CSIRO, Australia generously supplied necessary genes (maintained in *Agrobacterium*) and chemicals which I carried to the BAEC and initiated the research work in December, 1993. Since then, I maintained close contact with Dr. Serajul Islam's group in devising new experiments and solving many problems they encountered.

Later, I continued working at the Canberra lab of CSIRO, Australia, especially utilizing my weekends. After 2 years of work, I successfully developed genetically engineered jute plants and a procedure for routine introduction of genes into jute. In short, the procedure requires the contact of jute leaf tissue and a specific strain of bacteria called *Agrobacterium tumefaciens* harboring foreign genes. This bacteria has the natural ability to transfer foreign genes into plant cells. In this case, the bacteria contained a kanamycin resistant gene and a coloring gene called GUS. Once the bacteria has transferred its foreign genes into jute leaf cells they are developed into intact jute plants in tissue culture media by applying appropriate plant hormones. Chemical tests are then employed to determine the presence of the introduced genes in these developed jute plants, which confirms they are genetically engineered. This development opened a way for improving jute varieties with desired characters. This is a step forward for modern jute research. The long cherished dream of introducing insect or disease resistant genes or altering the quality or yield of jute fiber has appeared to be an achievable objective. Now, we are in the process of transferring this technique for its application by the scientists in Bangladesh.

This work could not have been initiated without the assistance from the TOKTEN program. Additionally, International Jute Organization (IJO) realized the importance of the work and offered financial assistance in the later part of the project. After the completion of the project i.e. the development of a genetic engineering technique for jute, IJO has recently approved two genetic engineering projects on jute with which I remain involved. One of the project deals with simplifying the technique and the introduction of insect resistant gene (b.t) to develop resistance against jute pests. This work is being carried out by me at the University of Minnesota, USA, and the genetically engineered jute plants will be subsequently transferred to Dr. Serajul Islam's group at the BAEC for further evaluation. The second project is to reduce the lignin content in jute fiber, which will also be carried out at the University of Minnesota in the beginning of 1998. Cotton fiber does not contain any lignin whereas jute fibers contain high (11%) lignin. This high content of lignin in jute fiber makes it fragile and less durable compared to cotton fiber's high flexibility and durability. Therefore, this project aims at developing a gene library of jute and isolating genes of lignin biosynthetic pathway. The lignin genes will then be transferred into jute plants in reverse orientation to reduce the production of lignin in jute fibers in order to make it more durable and flexible like cotton fibers.

Most would agree that Bangladesh is losing its trained intellects at an alarming rate. The country would be benefited if Bangladesh receives help from its 'once lost scientists and teachers to the overseas' probably by adopting the principle and activities of TOKTEN. Western nations realize the power and influence of research. Their richness is reflected on the direct results of huge investment in research and enables to attract scientists from other countries. On the contrary, the developing nations have poor research infrastructure, low research budget and an established trend of losing trained people. Thanks to the TOKTEN program undertaken by UNDP. Through this initiative expatriates can transfer their expertise to their respective motherland.

Bilateral programs of scientific cooperation can help develop countries. Israel, South Korea, Taiwan are just a few who benefit from strong bilateral scientific agreements with USA. Under these agreements, scientists can get financial help and can be involved in productive cooperation. We therefore wish that an initiative either from the Bangladesh Government or from the expatriate Bangladeshi nationals be taken to the USA Government for a bilateral scientific agreement between the US and Bangladesh. In this context, BCBSNA and their counterparts in Bangladesh can play major roles in bringing these parties together to develop mutually beneficial projects.

Researchers in Bangladesh are eager to get help from expatriate nationals and there are a lot of competent expatriate Bangladeshi scientists who are willing to help their motherland. But the TOKTEN program can only handle a fraction of the resources. I believe TOKTEN or TOKTEN related intiatives could and should be strengthened further to meet the demand of the native organizations in tapping the scientists of Bangladesh origin now living abroad. Proper research investment could make Bangladesh prosperous. The example we may keep in mind is that the USA generates $700 billion annual return by investing only $13 billion/year in conducting science and technology related research in the Universities.

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