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First sequencing of the rubber tree (*Hevea brasiliensis*) genome

A collaborative programme of work has been agreed between the Tun Abdul Razak Research Centre (TARRC) in Hertford, UK and the newly opened Genome Analysis Centre (TGAC) based at the Norwich Research Park, Norwich, UK, for the first extensive analysis of the rubber tree (*Hevea brasiliensis*) genome.

The successful outcome of this sequencing project will ultimately lead to rubber trees having improved characteristics such as disease resistance, latex yield, girth and timber quality.

The *Hevea* genome is one of the largest among cultivated crop species. For example, it is more than twice the size of the oil palm genome and more than five times that of the cocoa genome.

The project will utilise the extensive facilities at TGAC as well as those in TARRC's recently established Biotechnology Unit. To meet the major challenge posed by the size and anticipated complexity of *Hevea* genome, a combination of different sequencing platforms will be used to produce a high degree of genome coverage to maximise the quality of sequencing and assembly.

Natural rubber latex and rubberwood timber are two strategically important commodities and are of increasing importance to the world's economy as sustainability of such renewable resources is becoming a key consideration.

Malaysia is the world's third largest producer of natural rubber at more than 1 million tonnes and downstream activities associated with rubber product manufacturing and rubberwood processing and product manufacturing together contribute close to £3 billion to the Malaysian economy.

As a manufacturing nation, Malaysia is also the world's fifth largest consumer of natural rubber. Latex products represent 75% of the export value of rubber products from Malaysia (valued at £1.8 billion in 2007). Latex goods valued at around £0.9 billion are exported to the largest markets, the United States and the EU, each year.

The global healthcare sector uses dozens of billions of pairs of disposable gloves every year. Malaysia is the largest producer of these gloves and supplies well over half of the world's annual consumption of latex gloves in a market which continues to grow by around 10% per year.

Background information on TARRC

TARRC is the UK-based laboratory of the Malaysian Rubber Board (MRB) and was founded in 1938 to carry out fundamental scientific research into natural rubber, to establish its structure and explain its elastic behaviour. Its main role now is to promote and assist the Malaysian rubber and rubber products industries. Over the last 71 years the research centre has contributed to the development and modernisation of the Malaysian rubber industry. TARRC was known until the mid 1990s as the Malaysian Rubber Producers' Research Association and was at the forefront of key advances made in the fields of polymer science, engineering, testing, analysis and product development. These early years of scientific work has resulted in a background of unrivalled expertise in polymer science and engineering that covers rubbers, plastics and thermoplastic elastomers. TARRC has developed a worldwide reputation in the rubber industry as a centre of excellence and continued recognition of this position is strong, particularly by European companies and institutions.

Promotion of Malaysian-manufactured products and business opportunities in the industry is also given high priority by TARRC and through activities at international exhibitions in Europe that have resulted in substantial orders for Malaysian industry; the challenge is now to assist all Malaysian manufacturers in their efforts to become successful in securing more orders and to extend the range of high value-added products available from Malaysia.

In this context the Industrial Development and Promotion Division have responded to the needs of the industry with several projects specifically aimed at advancing manufacturing capability. Staff with years of global rubber industry factory experience carrying out regular factory visits under a Technical assistance Service. As companies improve their productivity, quality and efficiency they are able to adopt technology to grow to be high achievers for the advancement of the industry. MRB's A5 Project's aim is to raise the profile of rubber product manufacturing through improvements in efficiency and productivity in the factory, thereby improving profit margins. A new project A6 offers advanced manufacturing assistance and provides specialist assistance to a selection of companies and concentrates on offering product development assistance, through design, testing and validation using advanced technologies such as CAD/CAE.

The success of TARRC is due to its dedicated workforce from scientists and researchers, engineers and technologists through to marketing personnel and support staff. All are dedicated to deliver the utmost effort and contribution to develop the rubber industry in Malaysia.

An important role of TARRC is to provide training for secondees from MRB, Malaysian companies and Malaysian students.

Much of the scientific work of the early years began to has led to impressive advances such as the development of building mounts to isolate structures from ground vibrations which eventually led to the use laminated bearings for earthquake protection. The renowned design expertise of TARRC has been used to extend the array of devices for mitigation of seismic damage - some extend the concept of base isolation, such as the rolling ball isolator for lightweight structures and bearings that isolate in three dimensions, whilst viscoelastic dampers work within the structure.

Other recent successful achievements include TARRC's exploitation of the process of reactive mixing where compound properties are modified and improved through a chemical reaction effected during the mixing stage. Tyre rig tests have shown that a ten percent reduction in rolling resistance can be achieved for car tyre formulations mixed using this procedure.

Work carried out on epoxidised natural rubber (ENR), or Ekoprena™ as it is known commercially has concentrated recently on the technical promotion of the material as a 'green' replacement for SR in silica-filled tyre tread materials. The new project is timely as the tyre companies strive to develop technologies for more fuel-efficient tyres in response to concerns by the automotive industry to the rising fuel costs and a vehicles 'carbon footprint'.

Alongside the technical work, TARRC has been successful in raising the profile of ENR with tyre companies. It is apparent that the level of interest in ENR for use in tyres is increasing and this is an important development in the efforts to increase the uptake of ENR in tyres.

TARRC's Biotechnology Unit was set up in 2007 to strengthen the MRB's existing biotechnology capacity and complement its efforts in the improvement and better utilisation of natural rubber as an agricultural and pharmaceutical resource. The formation of a biotechnology group within the MRB follows Malaysia's policy to create a development programme to establish the country as one of the leading players in biotechnology in the Asia Pacific region. TARRC's close proximity to centres of excellence such as the John Innes Centre was one of the factors in setting up a new Biotechnology Unit at Hertford. Initial aims of the project include the sequencing of the rubber tree genome to improve latex yields and timber, as well as disease resistance and stress tolerance. Also, the rubber tree is viewed as a potential candidate for so-called molecular farming, when genetically modified plants are used as a cost-efficient source for production of foreign substances important for pharmaceutical or industrial purposes.

TARRC's consultancy arm, Rubber Consultants, was established twenty-five years ago to allow individual clients to have access to the expertise of TARRC's scientific and supporting staff and extensive laboratory facilities on a confidential basis. TARRC's excellence in polymer R&D has enabled Rubber Consultants to build up a large and varied client base that includes a wide spectrum of industries from all over the world, varying from sole traders to multinational companies. TARRC is certified as an ISO 9001:2000 company. Turnover generated by the Consultancy continues to rise year-on-year and provides essential revenue to support TARRC's R&D programme and at the same time many contracts increase the depth and breadth of staff's expertise.

TARRC is based in Brickendonbury, just outside of Hertford and just twenty miles from London. It employs over 80 scientific and supporting staff.

For more information on TARRC visit www.tarrc.co.uk

Background to TGAC

The Genome Analysis Centre (TGAC) has been established as a national centre in Norwich by the Biotechnology and Biological Sciences Research Council (BBSRC). The centre represents a partnership with economic development partners – East of England Development Agency (EEDA), Norfolk County Council, South Norfolk Council, Norwich City Council and the Greater Norwich Development Partnership – all of whom represent significant investment. TGAC is also provided with some capital investment from the John Innes Centre upon which site it is located, and therefore lies within the Norwich Research Park.

The areas of science that TGAC will concentrate on are those related to the understanding the genomes of economically and socially important plants, animals and microbes.

Sequencing of candidate genomes such as perennial ryegrass for a sustainable bioenergy option, livestock for greater understanding of resistance to disease, and fruit and vegetable crops with the aim to increase nutrient content will generate a large wealth of data. This will necessarily require the centre to become a national centre of excellence in bioinformatics – the application of computer science to biological research – in order to successfully handle and interpret the data.

One of the key aims for TGAC is to combine world-class genome science with an innovation programme that will benefit both the regional and the national economy as well as working with international collaborators. Advances made through research and development within TGAC will maximise the economic and social impact and cutting edge facilities will be made available to UK industry. Training and skills development is also an important part of the Centre's mission and one where it plans to introduce modular training suitable for industry as well as providing traditional MSc and PhD programmes.

As part of the Norwich Research Park, which is one of the largest concentrations of bioscience research in Europe, TGAC will play an important role in the Park's new vision.

For more information about TGAC visit: www.tgac.bbsrc.ac.uk