capacity were connected to the grid, one in Brazil, one in the Czech Republic, three in India and one in Pakistan.

Additionally, construction of three new nuclear reactors started in 2000 – one in China and two in Japan, bringing the total number of nuclear reactors reported as being under construction to 31.

Nuclear power provides about 16% of global electricity, with about 83% of nuclear capacity concentrated in industrialized countries. The ten countries with the highest reliance on nuclear power in 2000 were: France, 76.4%; Lithuania, 73.7%; Belgium, 56.8%; Slovak Republic, 53.4%; Ukraine, 47.3%; Bulgaria, 45%; Hungary, 42.2%; Republic of Korea, 40.7%; Sweden, 39%; and Switzerland, 38.2%. In total, 17 countries relied upon nuclear power plants to supply at least a quarter of their total electricity needs.

In North America, where 118 reactors supply about 20% of electricity in the United States and 12% in Canada, the number of operating reactors has declined slightly. In Western Europe, with 150 reactors, the overall capacity is likely to remain at or near existing levels in the coming years. In Central/Eastern Europe and the Newly Independent States, with 68 reactors, a few partially built plants are likely to be completed, while aging units are being shut down. Only in the Middle East, Far East and South Asia, with a total of 94 reactors at present, are there clear plans for expanding nuclear power, particularly in China, India, the Republic of Korea and Japan.

Worldwide in 2000, total nuclear generated electricity increased to 2447.53 terawatt-hours. Cumulative worldwide operating experience from civil nuclear power reactors at the end of 2000 exceeded 9800 reactor-years.

Table 1 shows the electricity supplied by nuclear power reactors in 2000 and the respective percentage of electricity produced by nuclear energy.

*IAEA public release material dated 3 May 2001 communicated by S. Ganesan, Theoretical Physics Division, Bhabha Atomic Research Centre, Mumbai 400 085, India (e-mail: s.ganesan@vsnl.com).

MEETING REPORT

Chickpea regeneration and transformation*

Among grain legumes, chickpea is an important crop of the Indian subcontinent as far as production and area under cultivation are concerned. It is a rich source of vegetable protein. However chickpea is losing its image as a poor man's meat due to high market prices, causing protein calorie malnutrition and under nutrition. The reasons for stagnation in its production are: susceptibility to insect pests, pod borer, fungal pathogens, and low tolerance to drought and low temperature stresses. Various insecticides and fungicides have been used to control insects and pathogens. Improvement in resistance by conventional breeding is limited due to the lack of sufficient and satisfactory levels of genetic variability within cultivated chickpea germplasm. Many wild annual *Cicer* species which possess a wealth of agronomically desirable genes are sexually incompatible to cultivated varieties[1,2]. An effective and alternative approach is to transfer genes from sources which are otherwise difficult to introduce through conventional breeding. The success of gene transfer depends on the availability of an efficient and reliable *in vitro* regeneration protocol. Chickpea, like other large-seeded legumes, is recalcitrant for *in vitro* regeneration and genetic transformation.

In view of lack of reliable protocols for regeneration and transformation of chickpea, the National Centre for Plant Genome Research (NCPGR) had organized a one-day workshop. The programme consisted of two main sessions followed by a round-table discussion. In the first session, K. K. Sharma (ICRISAT) presented an overview of the economic importance of chickpea, highlighting serious diseases and abiotic stresses that are major constraints in chickpea production. He also highlighted ongoing research at ICRISAT with the aim to introduce resistance against insect pod borer and fungal pathogens. Although regeneration could be achieved via direct multiple shoot organogenesis or somatic embryogenesis, the attempts for establishment of plantlets in soil had not been successful. Putative transformants of chickpea could be raised by biolistics and *Agrobacterium*-mediated transformation. However, the lack of efficient *in vitro* regeneration has limited the efforts for improvement of chickpea. V. K. Chowdhury (CCS HAU, Hisar) commented on the lack of reproducibility of regeneration protocols and highly problematic rooting and subsequent transplantation of the *in vitro* regenerated shoots, which was also a major limiting factor for obtaining complete transgenic plants and their progeny. He mentioned that his group had been successful in regenerating the transformed shoots using *Agrobacterium*-mediated and biolistics procedures. P. K. Jaiwal (MDU, Rohtak) reported direct and indirect *in vitro* regeneration of chickpea via organogenesis and somatic embryogenesis from diverse explants. A comparison of various selective agents along with the assessment of the compatibility of regeneration systems with *Agrobacterium*-mediated transformation was presented. The shoots recovered on selection medium from *Agro*-infected explants were found to be GUS-positive and could be rooted.

In the second session, K. V. Krishnamurthy presented the work carried out by his group on shoot organogenesis, somatic embryogenesis and protoplast culture of chickpea at NCL, Pune. He also discussed *Agrobacterium*-mediated transformation of chickpea using *gus* and

*A report on the one-day workshop on Regeneration and Transformation of Chickpea (*Cicer arietinum* L.) organized by the National Centre for Plant Genome Research, JNU Campus, New Delhi and held on 30 November 2000.

nptII or *bar* genes and analysis regarding their inheritance in subsequent progeny. He mentioned how he could recover mature transgenic plants by *in vitro* grafting of transformed shoots onto 5-day-old-dark grown seedlings. B. K. Sarmah (AAU, Jorhat) reported the work carried out at CSIRO, Australia on introduction of protease inhibitor gene from *Nicotiana alata* and α-amylase inhibitor gene from common bean into Australian desi chickpea cultivars. The T_1 seeds subjected to insect bioassay showed resistance to *Callosobruchus maculatus*. He also presented the work initiated at Assam Agricultural University on regeneration and transformation using Indian chickpea cultivars. D. V. Amla (NBRI, Lucknow) reported efficient regeneration through direct shoot formation, organogenesis and somatic embryogenesis from different explants on different hormone combinations. The regenerated shoots could be rooted and established in soil with 20–28% survival rate. Optimization of several parameters like processing of explants, *Agrobacterium* concentration, co-culture conditions and selection regime resulted in transformation frequency of 0.02–0.5%. The expression of 2.2-kb truncated *Bt-cry1Ac* was also achieved in primary transformants. J. Sen (NCPGR, New Delhi) discussed the ongoing research on improvement of nutritional quality by the transfer of desensitized aspartate kinase gene coding for the first enzyme of asparate amino acid biosynthetic pathway leading to the synthesis of some essential amino acids and also on developing fungal resistance against *Ascochyta rabiei* by incorporating antifungal protein genes isolated from *Dahlia merckii* and *Heuchera sanguinea*. In both the studies, primary transformants recovered on selection medium were positive in PCR studies and further molecular analysis on integration and expression of transgenes was to be carried out. P. Anand Kumar (NRCPB, IARI, New Delhi) presented results concerning the *in vitro* regeneration and *Agrobacterium*-mediated transformation of another important grain legume, pigeon pea. His group had regenerated chimeric pigeon pea plants expressing the *Bt-Cry1Ac*.

The round-table discussion noted that:

(a) Success has been achieved in regeneration via direct or indirect organogenesis and somatic embryogenesis from diverse explants on different media of many genotypes. But rooting of shoots, establishment of rooted shoots to soil and conversion of embryos to plants still pose problems, in addition to the genotype dependency of the methods. Moreover, regeneration protocols based on somatic embryogenesis are lengthy and difficult to reproduce. Regeneration of plants from protoplasts and anther cultures has not been achieved. For rooting of shoots, *in vitro* grafting method was suggested as the grafted plants established at higher frequency and grew faster compared to direct rooted plants.

(b) The transgenic chickpea plants have been obtained by both particle bombardment as well as by *Agrobacterium*-mediated transformation techniques. However, most of the workers have employed direct shoot organogenesis from cotyledonary node explants for *Agrobacterium*-mediated transformation and used *uidA* as reporter and *nptII* as selectable marker genes under the control of nos or CaMV 35S promoters. The frequency of transformation has remained low and the inheritance and stability of gene expression have not been studied. It was suggested that the other reporter genes, i.e. *gfp*, *luc*, etc. and selectable markers and the tissue and developmental stage-specific promoters (identified and isolated from chickpea for higher expression of transgenes) should be tried.

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Pawan K. Jaiwal* and Sonia, Department of BioSciences, M.D. University, Rohtak 124 001, India; and **K. C. Upadhyaya**, School of Life Sciences, Jawaharlal Nehru University, New Delhi 110 067, India and National Centre Plant Genome Research, JNU Campus, New Delhi 110 067, India
*For correspondence.

RESEARCH NEWS

Molecular link between diabetes and obesity: The resistin story

Nasreen Z. Ehtesham

Diabetes

Diabetes continues to be one of the oldest diseases widespread across geographical and genetic boundaries. Diabetes is defined as a condition that occurs because of lack of insulin or presence of factors opposing the action of insulin, resulting in an increase (hyperglycaemia) in blood glucose levels[1]. Poor control of diabetes leads to complications, which could damage small blood vessels throughout the body, thereby causing impaired delivery of nutrients and hormone to the tissues and eventually causing tissue-damage. Several tissues could be affected, causing corresponding diseases of the retina (retinopathy), renal glomerulus (nephropathy), nerve sheath (neuropathy) etc. Macrovascular complications have been associated with hypertension and dyslipidaemia, both of which are directly or indirectly linked to cardiovascular, cerebral, renal and peripheral atherosclerotic vascular diseases.

Forms of diabetes

There are two major kinds of diabetes: type 1 diabetes, known as insulin-dependent