

SCIENCE CONGRESS: research directions

Catching them young

Every year, the Indian Science Congress Association awards young scientists of the country. *Down To Earth* spoke to some of the winners about their work and how it can shape the country's future



KOUSHIK CHAKRABORTY

Plant Physiologist at Directorate of Groundnut Research, Junagadh

Salt-resistant oilseeds

Major oilseed growing areas in the country, like north-western plains in Punjab, Haryana, Rajasthan and Gujarat, have a soil with very high salinity.

My work involves identification of salinity tolerance mechanism in oilseeds and would help breed newer varieties tolerant to salinity. Such stress-tolerant varieties could be introduced in the coastal areas of our country and help increase total oilseed production.

Though India is an agro-based country, having the largest cultivable area in the world, as much as 8 million hectares of its land is affected by salinity and sodicity (a disproportionately high concentration of elemental sodium). And such areas are increasing. High rate of evaporation and transpiration, use of salt-contaminated water for irrigation and characteristics of some of the parent rock material from where the soil has originated mainly contribute to soil salinity in arable land.

Although India ranks second in groundnut and mustard production, it is still not sufficient to meet our daily edible oil requirement. Hence, India has to import edible oil.

We urgently need to increase both the production and productivity of oilseed crops.



PARIJAT ROY

National Geophysical Research Institute, Hyderabad

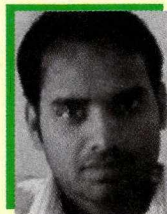
Tracers to study Earth

My research work is mainly focused on understanding the earth's processes, using geochemistry as a tool. Platinum group elements are powerful geochemical tracers to understand these processes, therefore, demand for these precious metals is high. Research in this field is limited in India as these elements are not mined in the country. I hope our research, coupled with modern analytical technologies, would help us explore hidden resources of these precious metals to fulfil their demand.

our study was based on the information collected from the traditional healers. They use it to treat many diseases, including suspected cancer cases.

We have developed a simple and first-of-its-kind method for isolation of cantharidin from these beetles. For our study, we crystallised the compound and performed its structural analysis. We have deposited the crystallographic data with the Cambridge Crystallographic Data Center, an online database of the crystal information of drugs.

Based on the findings from the present study, cantharidin could effectively inhibit cell growth due to Dalton's ascites lymphoma cell proliferation in several ways. However, the effect of cantharidin on human cancers needs to be examined further to ascertain if it could be used alone or in combination with other drugs. There is also a need for studies on the specific drug delivery system for cantharidin so as to reduce its toxic effects, if any, on the host.



AKALESH KUMAR VERMA

North Eastern Hill University, Shillong

Anti-cancer drug from beetles

My work is on the ethno-zoological practices of the traditional healers of Karbi Anglong district in Assam, India. I have isolated a potent anti-cancer drug, cantharidin, from two different blister beetle species, *Mylabris cichorii* and *Epicauta hirticornis*. The decision of including *M cichorii* and *E hirticornis* in



DIVYA SHARMA

Indian Agricultural Research Institute, New Delhi

Degradation of persistent toxins

I have worked on the microbial degradation of a persistent compound in the soil. To achieve enhanced degradation of the compound we used a biosurfactant-producing microorganism in consortia and have found that the organism worked well.

**AMIT MISHRA**

Faculty member at Indian Institute of Technology, Jodhpur

Proteins for neurological disorders

Synthesis and folding of proteins is the main quality control process that governs long-term health of a cell. Accumulation of misfolded proteins inside or outside of cells represents a clinical hallmark in neurodegenerative diseases such as Parkinson's, Alzheimer's and Huntington's disease.

For efficient quality control, cells always try to refold proteins prior to their degradation. How a cell recognises an abnormality in cellular proteins for their selective clearance from the crowded cellular environment remains poorly understood.

We have studied the detailed molecular mechanism of how certain proteins involved in quality control mechanism play a significant role in causing these diseases. Our work may help develop markers for these diseases and provide new lines of treatment for neurodegenerative disorders.

**ARVINDER SINGH**

Indian Institute of Technology, Kharagpur

Energy storage material

India would become the third largest energy consumer in the world by 2030. With an increasing energy need and fast depleting fossil fuel reserves, India would have to switch towards renewable energy sources like solar, wind, bio and geothermal.

The solution seems easy but large

scale implementation is hampered by the intrinsic intermittent nature and high cost of renewable energy-based technologies. Consequently, any future energy landscape would have energy storage systems as an intrinsic component. Such storage technologies will help in load leveling while ensuring continuity in energy supply.

I am currently focusing on one such energy storage technology known as "supercapacitor". My aim is to develop highly efficient, reproducible and low-cost electrode materials for supercapacitors. These low cost and locally fabricated supercapacitors would become cheaper alternatives to already existing energy storage devices that form an integral part of the renewable energy-based technologies.

**MALLAMMA V REDDY**

Bangalore University, Bengaluru

Computer-based translation

According to the Eighth Schedule of the Constitution of India, the country has 22 officially recognised languages as of May 2008. The Indian census of 1961 recognised 1,652 different languages in the country (including languages not native to the subcontinent). The 1991 census recognises 1,576 classified "mother tongues" in India. In the age of Internet, this multiplicity of languages makes it necessary to have sophisticated Machine Translation Systems.

My work is based on the human or natural language processing, particularly for machine translation. This could help a person communicate easily in any part of the country without knowing the native language. The project can also help researchers efficiently and accurately understand information and studies available in languages different from theirs.

Natural Language Processing (NLP) is a field of computer science, artificial intelligence and linguistics concerned

with interactions between computer and human or natural languages. Specifically, it is the process of a computer extracting meaningful information from human language input and/or producing human language output. The major task in NLP is machine translation, the process of automatically translating text from one human language to another.

**ABHILASH**

National Metallurgical Laboratory, Jamshedpur

Uranium extraction technology

Our work is focused on providing an alternative economically feasible and environment-friendly process for extracting uranium from low-grade ores. India plans to significantly increase the contribution of nuclear energy in electricity generation from a meagre 4 per cent at present by 2020. This would require more fuel, but that would mostly be imported as per the US-India Civil Nuclear Agreement. India is well endowed with uranium resources; it is of low grade (<0.024 per cent uranium content) but can be tactfully exploited. Current methods of extraction cannot extract the metal from such low tenor ore.

Based on our 10 years' experience in biohydrometallurgy and past five years' experience on uranium bioleaching, we have developed a process that uses such low tenor ore in a bioreactor to improve the rate of leaching. In this process, a combination of bacteria and bio-generated ferric ions fastens the slow bioleaching rate. This can enhance the uranium extraction yield to 90 per cent in 10 hours for such unusable raw materials. The work needs immense scale up trials on reactors and heaps (we have successfully conducted trials in 2 tonne columns), for commercial use. The work has the capability to put India on the path of self sustainability in the nuclear power sector.