Genetically modified crops claim their first victim

Arpad Pusztai of Rowett Research Institute, Scotland lost his job for publicizing his concern about the adverse effects of genetically modified crops on our health. The effect of a diet containing genetically modified potatoes expressing snowdrop lectin on the small intestine of a rat was published in a British medical journal[1]. It led to a spurt of media reports causing worldwide public concern about this issue. The research in question was funded by the Scottish Office of Agriculture, Environment and Fisheries Department and was carried out at three different research institutes located in Aberdeen, Dundee and Durham. The latter two groups were solely involved in the production and supply of transgenic plants and neither of them was involved in feeding studies made with rats at the Rowett Institute, Aberdeen.

Lectins are the group of proteins that bind to specific sugar moieties on body tissues. Lectins stimulate class II HLA antigens on cells that do not normally display them, such as pancreatic islets and thyroid cells[2]. Wheat gliadin, which causes coeliac disease, contains a lectin-like substance that binds to human intestinal mucosa[3]. This has led to the discovery of coeliac disease toxin but could be managed by gluten avoidance and nothing really to prove the lectin hypothesis. A few lectins, like those found in red kidney bean (PHA), concanavilin (Con A) have been found to cause dietary problems and damage to intestines[4]. Lectins as such are found in most of the foodstuffs and tubers like cereals, beans and potatoes. Soaking and boiling of the food naturally causes loss of lectin activity and even the most toxic lectins like PHA lose their activity on cooking. Besides their clinical and histological uses, lectins have been implicated in plant defence as far as back in 1976. After this first report of PHA killing cowpea weevil, many more lectins have been tested for their insecticidal activity. Since then genes for these lectins have been cloned and quite a few transgenics developed, which are in field trials. These transgenics are expected to be resistant against sap-sucking insects like aphids, plants and leaf hoppers. Other than potato, GNA lectin has also been introduced in crops like tobacco, sweet potato and maize. Lectins being highly resistant to digestion, also suppress the immune system. In some cases they have also been reported to cause allergic reactions. Before these genes could be put into commercial crops and made available to public, their toxicity to model mammal systems like rats was to be tested by feeding trials. With this in view, Rowett Research Institute, an internationally recognized centre for research in human and animal nutrition, of relevance to health, food and agriculture was chosen. The GNA or snowdrop lectin is mannose-specific and earlier studies showed it to be less toxic to humans. Experiments concerning the effect of GNA–GM potatoes were headed by Pusztai. Both GNA-modified and unmodified potatoes and also Con A (gene isolated from the American Jack bean) containing potatoes were used. The experiments showed that GNA-modified potatoes affected the rat intestine when fed for 110 days continuously. Further, ELISA results showed that the amount of GNA decreased drastically when potatoes were boiled for 1 h. The Con A containing potatoes did not significantly reduce the growth rate unless used at a concentration of 5000 times that expressed in normal transgenics. The lectins used in Pusztai's experiments were known to be toxic to insects and Gatehouse who developed these transgenic potatoes for the study was not surprised to find that GM-potatoes stunted the growth and damaged their immune system. Though the experimental results showed them to be less toxic than perceived, Pusztai went public about his views in a television programme even before his experiments were complete and consistent data were obtained.

This sparked much controversy on the safety of genetically modified foodstuffs. The Scottish office had commissioned Pusztai's study to investigate the role of lectins which might be used to increase resistance of plants to insects. Therefore, the potatoes were not intended to be commercially developed for human consumption and were really not put through the rigorous tests required for genetically engineered plants developed for human consumption. It was agreed upon earlier that published concepts relating to the use of lectins in transgenics could be discussed but not data which were not published or peer reviewed. Pusztai was soon suspended because some of the claims that he had made about the effect of GM-potatoes could not be substantiated by his data and a number of long-term feeding studies conducted by him were found to be incomplete.

This raised a huge hue and cry in the public for a moratorium on all GM crops. The Pusztai episode clearly shows the consequences of miscommunicating scientific facts to the public. Drawing premature conclusions from unconfirmed data will only complicate the issues. A moratorium on GM crops may not be necessary but carefully controlled research and progress in the area is needed.

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The fun of holding Indian Science Congress *melas*

I was amused to read K. N. Ganeshaiah's opinion[1], regarding the holding of national and international science conferences, taking the example of the International Botanical Conference. Similarities do exist between *Kumbh mela* and the Indian Science Congress also.

The 87th session of Indian Science Congress was held at Pune from 3 to 7 January 2000 and hosted by University of Pune, Bharati Vidyapeeth and National Chemical Laboratory. R. A. Mashelkar, Director General CSIR, was the chief architect and planner of this New Millennium Science Congress in the capacity of General President of ISCA. He gave a clarion call to the nation to adopt a new *panchsheel*, a five-point programme comprising child-centred education, woman- centred family, human-centred development, knowledge-centred society, all leading to an 'Innovative India'. Let us hope our national and state governments adopt this *panchsheel* in right earnest to build a new India.

The Prime Minister of India, as usual, was the chief guest for the inaugural session and the University of Pune was turned into a virtual fortress. It took me two hours from the University gate to reach the main pandal after crossing many security checks and barriers. I am of the opinion that we must get rid of this ritual of inviting the Prime Minister to chair the Indian Science Congress at least in the new millennium. This will do a lot of good to Indian science in general, and the delegates to the science congress, in particular.

The campus of the University of Pune, turned out to be a vast sea of humanity, creating all sorts of chaos for the delegates and the general public who came to visit the science and technology exhibition. Another attraction at the venue was the Kargil Exhibition put up by the Ministry of Defence which was open to the general public. The organizers may not have anticipated such a big crowd at the exhibition. It was a pathetic sight to see kids standing for hours in the queue waiting for their turn. Fortunately, there was no stampede as it happens in every *Kumbh mela* but there was total chaos.

The Science Congress at Pune was a high-tech affair. From the registration desk to the main pandal, information technology was introduced in full measure. However, it also caused unnecessary harassment. The attendance was quite poor in academic sessions but the response was good to the New Millennium Lectures organized in the main pandal.

The forum 'Science for School Students' did extremely well by organizing popular lectures by eminent scientists in the Chandrashekhar auditorium of IUCAA and a Children Science Congress sponsored by DST. Due to limited seating arrangements, many students were left in the lurch. There was so much enthusiasm to participate in these programmes that it led to gate crashing on all the days of Science Congress. A similar situation prevailed in the 'Food Village' which could not cater to the needs of the delegates and the public at the venue. Most of the volunteers felt exhausted and impatient to demonstrate the exhibits. 'Kargil pandal' was a big attraction where one could see the armaments used by our brave soldiers during the Kargil encounter.

Arun Nigavekar, the Vice Chancellor of Pune University and faculty members and students were always ready to help the delegates. But the student volunteers deserve full marks for making the Science Congress a success. It is estimated that a budget of Rs 8–10 crores is required to organize such a mammoth Science Congress in India. Is it worth the price? My personal impression is positive and I recommend that Indian Science Congress be organized as *Vigyan mela* (to match our *Kumbh melas*) for the popularization of science and technology amongst Indian masses. We should have no pretensions that Indian Science Congress serves any other purpose for promotion of science and technology.

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Problems facing S&T in India

This has reference to the article on S&T priorities by G. Padmanaban (*Curr. Sci.*, 2000, **78**, 381–382) in which he has reiterated several issues related to Indian S&T. The Indian science establishment is beset with several problems that have to be examined seriously and an in depth and a thorough overhauling implemented. While our success in certain areas like space technology cannot be sidelined, the fact remains that Indian contribution to science is still insignificant. And this is true not only of science as the West sees it, but even of science that is of relevance to our country. This indicates, if anything, a serious malady in the S&T establishment.

In spite of the fear of repeating what has already been discussed perhaps several times, I would like to mention briefly some of the aspects that need careful examination.

(i) *Open discussion*: A large number of people, including laymen, bureaucrats, politicians and even some scien-

tists, consider the investment in S&T as largely wasteful and unaffordable for a developing country like India. However, it is a fact that no country in today's world can afford to neglect S&T and survive. It is therefore necessary that the problems in this sector, their solutions and priorities for funding S&T be discussed openly at the national level. Apart from research in frontline areas, the society requires research work to be done in relation to mundane problems.

(ii) *Promotion of excellence*: Any scientific establishment has to promote excellence among its workers and not mediocrity. A scientist's quality is usually assessed based on his publications. But the number of publications alone cannot be an indication of a scientist's capability. One should see the impact of the paper and even of the journals. Certain areas of social importance may not have much potential for publication in reputed journals. In such cases, alternative methods of assessment have to be worked out.

A related problem is that of scientific ethics. While the number of cases of blatant violation of scientific ethics exposed in India is not very large compared to that in other countries, what is suppressed appears to be much more. Favouritism in every aspect, from selection of Ph D students and valuation of their theses to recruitment of researchers and assessment for promotion, often goes without even a whisper of protest. Scientists have to urgently and seriously address the issue of fudging of data and other misdemeanours.

(iii) *Working environment*: Many scientists often feel that the environment in Indian research institutes is not very conducive to creative work. Money is *not* often the main constraint. Widespread complaints are more about time delays in obtaining materials or getting the work done, overly restrictive administrative practices, low priority given by government officials to matters related to research, and so on. The government should initiate positive steps to attract private funding for research. Regarding job promotions, in spite of the efforts taken by the CSIR in streamlining the assessment promotion procedures, there still exists considerable discontent. Maybe it is necessary to completely recast the system and have a series of discussions at various levels.

(iv) *Attracting talent*: Even premier institutions like the TIFR are finding it difficult to find good staff for their projects. It appears that the younger generation is moving away from science into commerce, business administration and other lucrative fields. C. Subramaniam had suggested that the old Science Talent Programme be resurrected. If selected candidates have to take up science as a career, there has to be some assurance that they would get employment in the future. It may not be a bad idea to provide jobs for these candidates every year, of course, subject to the condition that they eventually qualify for the post. If we can have selected cadres in Administration, Police, Forest and even Engineering Services, why not for Science also?

I hope the scientific community will consider these suggestions. A committee consisting of senior and young scientists, university teachers, academicians, bureaucrats and management experts could be constituted to initiate discussions at various levels that would lead to a national consensus on these issues. In any case, it is high time something is done about the problems in the S&T sector if India is not to fall far behind the other developing countries.

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Issues regarding S&T in India

The articles in *Current Science* (2000, **78**) by P. Balaraman (pp. 365–366), K. N. Bharadwaj (p. 368), M. Mukul (pp. 368–369), and G. Padmanaban (pp. 381–382) raise the following issues for the *immediate attention* of organizations like DST, UGC, CSIR, ICAR, ICMR, universities and research institutes, industries and researchers themselves.

1. Facilities for research in various disciplines are governed by the quality of scientists recruited for the purpose. As long as equipments are properly used by scientists and students, their maintenance is usually assured by service contracts and funds from projects/institution itself.

2. It is true that some scientists have denied to share their facilities with other users even when the equipment is almost idle due to various reasons. Joint authorship is necessary wherever intellectual interaction is involved.

3. Funding should be given to deserving scientists and not be based on mere 'contacts with right persons'.

4. Instrumentation centres in most institutions are in a bad state because qualified staff have not been appointed to design new instruments/equipments, and keep the older ones going much longer.

5. Fruitful cooperation between academia and industry can occur only if there are dedicated scientists and the industrialists are willing to use Indian technology for their products. Institutions/departments should circulate brochures mentioning their field of expertise and achievements. In the process, the academics should ensure

that their academic commitments are not hindered. Institutional and personal ethics should be developed and fostered, defaulters should be dealt severely.

6. Committed teachers and scientists, and reasonable infrastructure will help to prevent brain drain.

7. Undue priorities and biased/favoured discriminatory funding without regard to quality achievements, and relevancy and just 'right contacts' will not nurture young creative minds.

8. The lack of quality teachers in various science branches in most institutions, has led to a decrease in the number of students taking up basic science for study.

9. Hence, the present system of education should be restructured with course–semester pattern and good teachers.

It is thus time for all those concerned to get together and work for rapid improvement.

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Science popularization and the Indian Constitution

Excited by the on going discussion among politicians, lawyers, academicians, etc. about the review of the Indian Constitution, I browsed through the parts of the Constitution dealing with fundamental rights and duties to find out whether these have anything to do with my 'right to information' as a scientist (in the sense one who searches for new information). When it came to fundamental duties, I was surprised to see one item very specific to scientists or intelligentsia. This part [article 51A(h)] reads, (citizens have a duty) 'to develop the scientific temper, humanism and the spirit of inquiry and reform'. All other items, totalling ten under duties, are perhaps ordinarily established by finer laws or regulations. Article 51A(h) alone is of a subtle nature and seems to need inputs from governments, NGOs and voluntary groups of educated or devoted citizens (especially scientists).

This item under basic duties is of great importance to those popularizing science, since they too are trying to develop scientific temper, humanism and spirit of inquiry and reform (or modernization). In India where biased regionalism, jingoism, superstitions, etc. are practised, popularizing science and its material benefits are good ways of reform and progress. Central government institutes like National Council for Science and Technology Communication (NCSTC), National Information System for Science and Technology (NISSAT), Central Health Education Bureau, Centre for Environment Education, National Institute of Science Communication (NISCOM) and Science magazines like *Science Reporter*, *Down to Earth*, *Resonance*, *Vigyan Pragati* and many newspapers are trying to popularize science. National Science Day is observed on 28 February in memory of C.V. Raman. National Children's Science Congress is regularly organized to encourage children (10–17 years) to relate the learning of science to their immediate social and physical environment. Schools, colleges and NGOs also contribute considerably to popularization of science. CSIR laboratories are expected to organize open days for the general public during the CSIR foundation day in September. (See *Vistas in S&T Communication*, 1992, Publications and Information Directorate, CSIR, New Delhi for elaborate details on science popularization in India.) Altogether, India seems to be on the right track in science popularization.

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