Are transgenic crops a threat to bio-diversity?

Our country is on the threshold of taking a decision on the commercialization of transgenic crops. There have been concerns expressed from a few quarters about the possible effects of transgenic crops on bio-diversity. A critical and balanced examination of the issue however, suggests that such concerns are not valid and are probably borne out of a lack of understanding of the various facets of modern agriculture. Let me emphasize that I am coming to this conclusion not because I work at the Monsanto Research Centre.

If we trace the evolution of agriculture, it has been through the selection of a few plant species from among thousands, as cultivated crops to provide food and other useful products. Even from among these chosen crop species, there has been a conscious effort over several millennia to select those variant forms for their productivity and/or other useful agronomic attributes. Selective cultivation of a few species, and a few varieties in each of these species has been a continuing feature in agriculture. With the advent of modern farming, this process has accelerated considerably. A few decades ago, there would have been hundreds of varieties of any major crop, say rice, in cultivation. But with the green revolution, there may not be more than a dozen rice varieties now, that contribute to most of India's rice production. Dependence on fewer and fewer crop varieties has come to be an inevitable consequence of trying to increase agricultural productivity to meet the challenges of growing population.

The introduction of transgenic crop varieties does not add any new dimension to this scene in modern agriculture. If a variety, whether it is transgenic or not, has high productivity combined with useful agronomic attributes, it will be accepted by farmers over some existing variety in a specific location. The acceptance of any variety, particularly food crops like rice, would also depend on consumer preference, which is bound to be different in different geographical locations. Therefore, if a foreign gene, that could be used for crop improvement through genetic transformation, has to gain wide acceptance, it has to be introduced into many different genetic backgrounds. During the green revolution years, the land (traditional) varieties, which had low productivity, were gradually replaced by different high yielding varieties (HYVs), each with adaptability and acceptance in different locations. Again to cite an example from rice, the HYVs popular in Kerala are so different from the ones cultivated in the neighbouring state of Tamil Nadu.

The land varieties, and some of the wild and weedy relatives may not have much value as cultivated crops. However, plant breeders have long recognized that they may have a value in future crop improvement programmes, say as sources of resistant traits. This is the reason for large investments in gene and germplasm banks that attempt to conserve all the diverse types available in crop species. All the major International Crop Research Centres are mandated to preserve the germplasm of the concerned crops and make it available to researchers throughout the world. The International Rice Research Institute has a collection of over 90,000 rice germplasm accessions from different parts of the world. In India, we have the National Bureau of Plant Genetic Resources (NBPGR), and many regional crop research centres including the agricultural universities, with large *in situ* and *ex situ* germ plasm conservation programmes for major crops.

These germplasm centres now concentrate on preserving the genetic diversity of the major crop species only. This is because, in conventional breeding, reproductive barriers limit the range of diversity that could be used for crop improvement to near relatives. On the other hand, modern tools of genetic modification allow the transfer of genes between any two living organisms. The *Bt* gene, that has been transferred to several crop plants to confer resistance to insect pests, is from a soil bacterium. Biotechnology opens up the use of all bio-diversity for crop improvement and thus justifies further investments and efforts to preserve all life forms.

We are deluding ourselves if we believe that modern plant varieties, leave alone transgenic crop varieties, are a cause for the loss of bio-diversity. The depletion of bio-diversity is due to the increasing numbers of just one species – the *Homo sapiens*. Yes, it is the uncontrolled increase in human population that is straining the agricultural systems to increase productivity, and this inevitably leads to choosing a few varieties over thousands of others. The need for preservation of bio-diversity in gene and germplasm banks cannot therefore, be overemphasized. The argument that transgenic crops are a threat to bio-diversity is simply misleading. As long as the human population continues to increase and more food has to be produced, let us not tolerate such specious arguments that prevent the use of modern technology in agriculture.

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Bioinsecticides from plants

A recent report from the Ministry of Food and Civil Supplies, Govt of India, New Delhi, shows that annual estimated post harvest loss of food grain is of the order of about 20 million tonnes which is the total food grain production in Australia. Considering that 203 million tonnes of food grain were produced during 1998–99, 5.8 million tonnes may have been destroyed by insect pests in storage. This amount would be enough to feed 380 million people for a month (based on per capita consumption of 450 g/day)[1]. Since insects have developed resistance towards conventional synthetic insecticides such as methyl bromide and phosphine, repellents for the management of such insect pests need to be developed.

The article by George *et al.*[2] is a welcome effort to search for biodegradable insecticides of natural origin.

Over 2000 plant species are reported to possess insecticidal properties. In our laboratory at Central Institute of Medicinal and Aromatic Plants (CIMAP), we have undertaken an exhaustive programme on screening of prospective natural products of plant origin. We have been able to identify essential oils of *Mentha citrata* and *Pinus longifolia* against *Sitophilus oryzae*[3], and *Cedrus deodara*[4,5] and *Matricaria chamomilla*[6] against *Callosobruchus chinensis* as potential grain protectants, and two Indian patents on the process of pulse beetle pest repellent tablets (Ref. No. 2441/Del/1995 dated 27.3.97 and 1974/Del/98 dated 10.7.98). We have also reported that essential oil from *Cedrus deodara* is effective against insect pests like *Anopheles stephensi*[7] and *Musca domestica*[8].

The report by George *et al.* that *D. hamiltonii* root possess strong aromatic odour that helps long storage of grains is quite attractive but the effective dose proposed is known to be toxic to *B. coli* at 0.041% concentration and 0.02% to fish. Furthermore, in the 1940s there was a report that a bacteriostatic compound arrests the growth of *B. coli*[9]. It could have been better if investigators of this had provided information on grain protection efficiency for 1, 3 and 6 months instead of 1, 3, 7, and 21 days only. Repellents leading to insect mortality are preferred to protect food grains rather than insecticides with direct toxicity against target insect pests. Moreover, this kind of work should be under study of shelf life, odour value and taste of product acceptable to human consumption, seed germination, etc. If an active compound is being recommended for use in protecting grains from insect pests, its effects on test animals should be studied for carcinogenic and mutagenic properties.

The main reasons for slow progress in developing bioinsecticides of commercial value appear to be (i) enthusiasm for quick publication, (ii) evaluation of materials against non-target insect pests, (iii) arbitrary dosage of testing material and standard, (iv) lack of facility for safety test of products, (v) short duration of the study, and (vi) improper survey of scientific literature. Most Indian scientists hesitate to refer to any work of Indian origin. There is a wealth of knowledge available in Indian scientific traditional literature. While planning such studies, we should pay better attention to areas like sound experimental designs, supply of raw materials, higher bioefficacy, industrial interests, simplification of natural insecticide registration procedure, knowledge on insecticide formulation techniques, collaborative efforts in R&D, and development of trained R&D manpower. Those involved in formulating the policy for such studies can minimize the hurdles present if concerted efforts are made in this direction.

Search for bioinsecticides from plant species is one of the important areas where Indian scientists can take a lead and capture the global synthetic insecticide market[10]. Besides, work carried out in this area may fetch a large number of patents in a shorter duration of study.

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Comment on an editorial

Though the editorial 'Editors' (*Curr. Sci.*, 1999, **77**, 1121–1122) was probably provoked by the article 'From Auschwitz to Indian science' in the same issue (*Curr. Sci.*, 1999, **77**, 1134–1136), an important observation in that article was ignored, viz. that the unpleasantness of discussing the mass annihilation of human beings is circumvented by altering the vocabulary of discourse. For instance, considerations of the kilodeaths that would result from nuclear explosions are evaded by focusing on discussions of kilotonne yields, a seemingly innocuous term. Such discrimination between obviously correlated concepts was illustrated in the article by a reference to a scientific journal (changed at the suggestion of the Editor to the explicit mention of *Current Science*) publishing kilotonne yields and rejecting kilodeath estimates. The close relationship between the two concepts was stressed in the article by referring to them in the same sentence; instead, the editorial articulated separate defences of its treatment of kilotonne yields and kilodeath estimates.

Further, with regard to the official/government estimates of the yield of the May 1998 Pokhran II tests, the implicit complaint in the article was not that they were published, but that counter views were not pro-actively elicited and revealed. In doing so, *Current Science* behaved like an official journal, rather than as an independent *Nature*-like forum facilitating discourse and discussion and encouraging scientists, in the language of the editorial, to 'express an opinion that is contrary to what is perceived as an accepted establishment view.'

On the other hand, the editorial must be congratulated for raising fundamental questions regarding the importance of debate and differences of opinion. It