Adverse effects of antioxidants

The recently reported cardioprotective effects of *Cichorium*[1], stem from its antioxidant properties. The cardioprotective effects of many other antioxidants are well-documented in the literature[2]. However, their role as prospective pharmacotherapeutic agents remains a moot question.

It is known that the antioxidant ascorbate can assume the role of a pro-oxidant in presence of iron, which may occur in free form in the iron-overloaded patients. In normal physiological conditions, most of the transition metal ions exist in bound state. However, injury to tissues may lead to the release of iron and copper which may prompt ascorbate to act as a pro-oxidant[3]. Though the Cambridge Heart Antioxidant Study (CHAOS) demonstrated beneficial effects of α-tocopherol in patients with angiographically proven symptomatic coronary atherosclerosis[4], the α-tocopherol β-carotene cancer prevention (ATBC) study did not find any significant effect of α-tocopherol on fatal ischaemic heart disease in a group of male smokers having a history of myocardial infarction. Some beneficial effects of the antioxidant were observed on non-fatal myocardial infarction. However, use of both the dietary supplements, especially β-carotene, was associated with an increased risk of fatal coronary heart disease[5]. In this context, it is worthwhile to remember the comments of Steinberg (California University, San Diego): '. . . we do not have data showing that the long-term (and presumably lifetime) intake of very large doses of natural antioxidants will not be toxic. Studies in humans have rarely gone beyond six months and have never involved thousands of subjects. . . . Having inadequate data on the benefit to be expected, we should hesitate to accept any potential risk.[6]'

1. Nayeemunnisa and Kumuda Rani, M., *Curr. Sci.*, 2003, **84**, 941–943.
2. Chattopadhyay, M. K., *Int. Pharm. J.*, 1994, **8**, 250–251 and references therein.
3. Halliwell, B., *Biochemist*, 1995, **17**, 3–6.
4. Stephens, N. G., Parsons, A., Schofield, P. M., Kelly, F., Cheeseman, K., Mitchinson, M. J. and Brown, M. J., *Lancet*, 1996, **347**, 781–786.
5. Rapola, J. M., Virtamo, J., Ripatti, S., Huttunen, J. K., Albanes, D., Taylor, P. R. and Heinonen, O. P., *Lancet*, 1997, **349**, 1715–1720.
6. Steinberg, D., *N. Engl. J. Med.*, 1993, **328**, 1487–1489.

M. K. CHATTOPADHYAY

Centre for Cellular and Molecular Biology,
Hyderabad 500 007, India
e-mail: mkc@ccmb.res.in

Plant biotechnology

Realizing the importance of agriculture to the Indian economy and in accelerating the process of development, a special section of the *Current Science*[1] was recently brought out on the application of plant biotechnology in crop improvement. The reviewers have made several useful observations explaining the institutional framework and codal procedures, review of the progress, indexing the plant breeder's perceptions on the issues to be tackled, advances in the engineering of host plant resistance, the awaited improvements in the plant variety act, and positioning India in the context of the ongoing global R&D environment. In fact, all those who were assigned the job have done an exceedingly good job. My attempt here is to do the semantics that is necessary to bring about a national level alliance between the various stakeholders of biotechnology and prioritize what is to be done by individual actors to achieve this goal of putting plant biotech business/programme in India on a strong footing.

Pental[2] has suggested major programmes to study genomic variability in viruses, gene mining for agronomic traits, development of genetic transformation in well-adapted dry land crops particularly the grain legumes, for nutritional improvement, hybrid development, etc. The perceived important breeding objectives based on the information collected from various individuals[3] seem to have a bias/tilt in favour of biotic stresses at the cost of other issues and hence the need to respond to the entire issue of priority setting.

The rapid area and productivity increase of cereals during the Green Revolution era enabled India to distance itself from the recurrent food shortages. The decelerating cereal production growth rates during the last decade and the mounting import bill from pulses and vegetable oil have necessitated the need to have a careful re-look at our national plant biotechnology agenda. As the population growth has hardly shown any symptoms of fatigue, continued agricultural production increase has to be achieved in a sustainable manner by adopting the ecosafe production methods. The important agricultural issues are:

- Improving crop productivity per unit area, input and time.
- Enhancing the precision and efficiency of the varietal breeding programme.
- Effectively countering the anticipated and prevailing biotic and abiotic constraints.
- Improving the agricultural harvest for end product quality and movement in value addition chain.

If water is available, in many parts of India, more than one crop per year can be grown and by increasing the per day productivity through increased cropping intensity alone India will be able to address the demand for food, fodder, fiber and fuel. Creating new variability is the crux of the varietal improvement exercise. Mutation breeding, wide crosses and such laborious and time-consuming approaches were used to develop genetic stocks and pre-breeding materials. But with the development of transgenic technology it is now possible to move functional genes from one organism to another. Developing a reliable marker-assisted selection (MAS) to transfer the novel gene from the stock to different varietal backgrounds should be our immediate priority. For this, access to advanced instrumentation and chemicals will be required. And only some laboratories have the automated high throughput facilities. This is a very serious limitation for further progress in agricultural biotechnology.

As the per capita income increases and both men and women move to gainful employment, the food consumption pattern and the kitchen need change. So a major part of cereal, fruits and vegetables will go for processing and value addition. The nutritional and other qualities of the material may have to improve to suit processing needs. Since these are polygenic traits difficult to select in early generations, a well-designed molecular approach would complement the several other ongoing efforts.

To move further to specifics that plant biotechnology needs to address, it is felt that irrespective of the crops the following are the various traits that are important: Resistance to insect pests; Resistance to viral diseases and plant pathogen; Tolerance to soil salinity; Tolerance to terminal heat/moisture stress; Upward movement in terms of quality; Enhancing the nutritional value.

Advances made in the development of transgenics in rice (*Bt*), mustard (hybrid) and potato (protein) should be augmented and made fit for commercial usage. While progress has been made in insect pest (Lepidoptera) management through *Bt* gene-based transgenics in cotton and other crops, there are still a lot of opportunities for developing systems to contain other pests. In fact, tomato can be taken as a model system for viral resitance transgenics and has several advantages over other vegetable crops. Though a difficult system, chickpea/pigeonpea/mungbean needs greater attention for biotic stresses due to pod borer, bruchids and nutritional enhancement.

The promoter commonly used in cassette design, the reporter gene, and the genes for the target traits which form the core of the transgenic technology are totally controlled by various multinational patents. This limits the scope of the commercialization of transgenics that have been indigenously developed, as still there are several restrictions on their usage. The task before us is to clone novel tissue/stage/specific/inducible promoters as well as genes of agricultural importance. A number of viral genes have been sequenced and deposited with the international repository. Also the plant virology group has made gene cassette with antisense coat protein gene and the transgenic developed for tomato leaf curl virus is under evaluation. This sort of virus gene mining from simpler systems is necessary so that an Indian replacement for the CaMV35S promoter can be identified.

Despite the claims coming from various Indian laboratories on the transgenics they have developed, the hard truth is that these are far away from commercial usage. A mire of different patents regulates the technology and constructs used in developing these transgenics. Unless it is negotiated with the concerned parties and royalties are paid, the commercial use of these transgenics shall remain a mirage. Even though many public-funded research institutions in India including the IARI have developed different transgenics, they have not examined them from the angle of the various patents that govern their product. The road map to transfer the product developed by them to the seed industry has not been drawn, as the scientists and technocrats have distanced themselves with this reality that is bound to cost the development of biotech business in India. These issues could have been addressed in the special issue.

1. *Curr. Sci.*, 2003, **84**, 297–424.
2. Pental, D., *Curr. Sci.*, 2003, **84**, 413–424.
3. Grover, A. and Pental D., *Curr. Sci.*, 2003, **84**, 310–320.

S. NAGARAJAN

Indian Agricultural Research Institute,
New Delhi 110 012, India
e-mail: snagarajan@flashmail.com

High yield of rainfed cotton through transplanting

With reference to the recent debate about the efficacy of *Bt* gene[1] in improving the yield of cotton, we report a very simple technique to increase the yield of rainfed cotton, without resorting to any genetic manipulation.

Out of about 1.7 million hectares under cotton in Maharashtra state, almost 98% is rainfed. Although the monsoon generally brings rains by about 15 June, farmers delay the sowing of the seed by almost a month, waiting for the soil to be sufficiently wet to ensure good germination. As a result, the seed of rainfed cotton gets sown by about 15 July. The monsoon generally ends by about 15 September, so that a crop that stands in the field for about 6 months, gets water only for the first two months. Because the development of the bolls takes place under drought stress, the yield of such cotton is very low.

It was shown that the yield of cotton could be doubled by planting cotton seed into plastic bags in the month of May and transplanting them into the field in the month of July. In this way, the plants receive water for almost 4 months, instead of just 2. Another advantage of this technology is that the date of planting is advanced by two months, so that the farmer not only gets an early harvest but his crop also escapes the heavy build up