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Current scenario of transgenic crops in India

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To meet the requirements of growing population utilization of transgenic crops is not being recognized at present. This is due to the result of concerns raised by the public and the critics about their applications and release into the environment. These include effect on human health and environment, biosafety, world trade monopolies, trustworthiness of public institutions, integrity of regulatory agencies, loss of individual choice, and ethics as well as skepticism about the real potential of the genetically modified plants, and so on. In this review paper our objective is to analyses the advantages and disadvantages of growing transgenic plants, as well as to analyses the scenario of transgenic crops in India for securing and increasing crop production.
Keywords: Transgenic crops, India, genetically modified crops.

Introduction

Many countries have banned transgenic crops cultivation as unsafe and in Russia it is a terrorist act to import them. The primary source of food is agriculture but the modern agricultural practice is burden on the environment as it is resulting in contamination of drinking water and underground water table, soil erosion and degradation and danger to biodiversity (Frison et al. 2011).

In this review paper our objective is to analyse the advantages and disadvantages of growing transgenic plants, as well as to analyse the scenario of transgenic crops in India for securing and increasing crop production. The first commercial transgenic crop in year 1992 was sown in China. The countries with the largest area of transgenic crops today are the USA, Argentina, Brazil, Canada, China and India (GM Compass 2009). A total area of 134 million ha in 2009, which in year 2011 increased to 160 million ha. The speed with which GM crops have spread has been impressive and its large-scale cultivation began in 1996. Three largest companies in world have been utilising plant gene technology and also they control the 70 % of global transgenic seed sales are Monsanto, Dupont and Syngenta (Vandana et al. 2011). In 1994 first GM plant was released for human consumption was the *Flavr Savr* tomato, which was characterised by extended shelf-life but it was withdrawn due to lack of consumer acceptance.

According to International Services for the Acquisition of Agri-Biotech Applications (ISAAA) India has the fourth largest area planted under transgenic crops, a total 11.6 million hectares (mh) was under transgenic plantation in year 2014, only after, Brazil (42.2 mh), Argentina (24.3 mh) and USA (73.1 mh). Currently across the world approximately 181.1 mh area was used for the transgenic crop plantation.

In year 2009, India's Maharashtra Hybrid Seeds Company (Mahyco) and US based company Monsanto with has developed Bt eggplant (*Solanum melongena*) by inserting a crystal gene (Cry1Ac) from B. thuringiensis (Krattiger, 2010; Cotter, 2011). But still the Indian Government has imposed a moratorium on its release after its commercialization due to the public resentment (Report of the Expert Committee (EC-II) on Bt Brinjal Event EE-1, 2009; The Times of India, February 9, 2010). Nearly 96% (nearly ~ 11.57 mh) of the country's cotton area is now covered by Bt hybrids.

Pros and cons of transgenic crops

Despite of various advantages the use of transgenic plants for human welfare has been restricted owing to various concerns raised by the public and the critics. These concerns are divided into different categories, namely, environmental, health, nutritional, ecological, socioeconomic, and ethical concerns.

Certain groups of public, including religious bodies, find it very unethical or inhumane to introduce human or animal genes into plants (Whiteman 2000). For example, the transfer of animal genes such as α-interferon gene into plants is objectionable to the vegetarians. Such concern was one of the reasons due to which the concept of "edible vaccines" did not gain much impetus.

There is a potential risk that the GM plants may hybridize (or cross-breed) with sexually compatible wild-type species. This genetic exchange is possible due to wind pollination, biotic pollination or seed dispersal. This may have an impact on the environment through the production of hybrids and their progeny. It is also speculated that the nutritional composition of GM products may be affected in GM plants. Another concern is that the transgenes from animals (obtained from fishes, mouse, human, and microbes) introduced into GM plant for molecular farming may pose a risk of changing the fundamental nature of vegetables. The public is worried about the risk that the GM plants can spread through nature and interbreed with natural organisms, thereby contaminating "non-GM" environments. Non target effect, that is, undesirable effect of a novel gene (usually conferring pest or disease resistance) on "friendly" organisms in the environment, is another concern related to GM plants (Pimentel and Raven, 2000). The public has long been worried about the loss of plant biodiversity due to global industrialization, urbanization, and the popularity of conventionally-bred high-yielding varieties. It is speculated that the biodiversity will be further threatened due to the encouraging use of GM plants. This is because development of GM plants may favor monocultures, that is, plants of a single kind, which are best suitable for one or other conditions or produce one product (Sweet and Shepperson, 1997). Further, the transformation of more natural ecosystems into agricultural lands for planting GM plants is adding to this ecological instability.

It is speculated that the random gene insertion, transgene instability, and genomic disruption due to gene transfer may result in unpredictable gene expression. Such a risk is, however, unlikely to be unique to GM plants or of any significance considering our current knowledge of genomic flux in plants. Plants adapt to the fluctuations in the environment through changing their genes and developing better races called "evolved races." These mutations, however, occur at a very low frequency (i.e., one in about 109/gene/generation). It is hypothesised that the cultivation of GM plants by the farmers at an increasing rate throughout the world may change the evolutionary pattern drastically. Another concern is the evolution of non-GM plants through hybridisation with GM plants. Public is also concerned about the potential risks associated with gene transfer from plants to microbes. The third health risk is related to the ability of GM plants to create new toxic organisms. It is speculated that some non-pest microbial strains may acquire pathogenic trait by gene flow from GM plants (Kaeppler, 2000).

Conclusions

There are not even scientific explanations for some of the concerns, but today the amount of misinformation is such that it has become difficult to separate truth from public perception about the GM plants. The biotechnology scientists, however, believe that GM plants should be given public acceptance because most of the concerns are not specific for GM plants and can exist for non- GM plants as well.

There is a wide range of existing and emerging problems related to food security that can be tackled by a range of crop technologies. Key areas include pest and disease control, salt and drought-tolerance, crop yield and quality, and the sustainability and environmental impact of crop production. The knowledge gained from basic plant research will underpin future crop improvements, but effective mechanisms for the rapid and effective translation of research discoveries into public good agriculture remain to be developed. Maximum benefit will be derived if robust plant breeding and crop management programmes have ready access to all the modern crop biotechniques, both transgenic and non-transgenic, to address food security issues.

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