Abstract:

Since years, most of the research studies are mainly focused upon microbiological and human health care. But in today's era, molecular plant studies are gaining more interest of scientists because these findings are an important and inseparable part of an ecosystem as they are not only food producers but also regulates the balance of gases in atmosphere, and at present plays a significant role in production of transgenics. Plant genetic studies were primarily carried out by conventional breeding. Recent advancement in genetic studies introduced a gene modification technique known as Genetic Engineering which not completely replaces convention breeding technique instead is a better tool with high efficiency. In this article we will discuss about importance of Genetic Engineering, it's comparison with conventional breeding practice as well as its advantages and future aspects.

Key words: Conventional breeding, Genetic engineering and Transgenics.

Introduction:

Conventional breeding was practiced for crop improvement, but the process was time consuming and labour intensive (Christou et al., 2013). Therefore, the recent advancement in recombinant DNA technology and molecular genetics are currently establishing comprehensive changes to the modern society. It still not completely replaces conventional plant breeding though it is a modern tool that helps breeders to fasten their breeding programmes (Kaiser et al., 2020). In this, the dealing with microbes, plants or animal cells to produce desirable products beneficial for the society (Gupta et al., 2016). This area covers an important modern technique i.e., Genetic engineering.
Genetic Engineering is one that covers advanced technologies manipulating the genome of a host organism to improve and enhance its key values to support sustainable production of food components, energy, bioremediation and even therapeutic derivatives (Wang et al., 2017). Transgenesis is the first artificial genetic modification technique achieved using genetic engineering in which the genes are transferred from one organism to another (Low et al., 2018). It was first introduced by Herbert Boyer and Stanley Cohen in 1973. This is the process to produce transgenic plants whose genomes has been altered by the introduction of a foreign gene or genes from another species (Key et al., 2008). Their genetic material is modified in such a way that does not occur naturally through fertilization or recombination. Examples includes resistance to certain insects, pests’ diseases, or severe environmental conditions, or resistance to chemicals (e.g., resistance to an herbicide), or also improving the nutrient profile of the crop (Kumar et al., 2020).

The first transgenic plant was kanamycin-resistant transgenic tobacco line reported in 1983 (Sarkar et al., 2014). Moreover, the major GM crops grown include sugar beet alfalfa, canola, maize, papaya, potato, soybean, squash, cotton and. The farmers recently cultivated approximately 190 million hectares of biotech crops (ISAAA, 2020b). The four primary cultivated crops considered by ISAAA are Maize (~30%), Soybean (~50%), canola (~5%), cotton (~13%) (ISAAA, 2018, 2020b).

**Advantages of genetic engineering over conventional breeding:**

1. Genetic engineering have made possible to make more beneficial crop varieties (Muntaha et al., 2016).

2. Unlike selective crop breeding, genetic engineering is more gene-specific and that it introduces specific genes where the end products such as proteins, metabolites or the phenotype are well characterized (Datta, 2013).

3. The process of genetic engineering is much faster than selective breeding raising crops with desired traits such as genetically engineered plants with more desirable traits are drought-resistant plants, disease-resistant crops, plants (e.g., legumes) fortified with more nutrients. Genetic Engineering could increase genetic diversity (Powell, 2012).
4. In classical breeding the genomes of both the parents are mixed together and gets randomly re-assorted into the genome of the offspring which can result in transmission of undesirable with the desirable genes and therefore leads to linkage drag (Kumar et al., 2020)

5. Moreover, recombinant DNA techniques introduces new traits at one time only excluding extensive crossbreeding as in case of conventional breeding. GM crops benefit the environment by substantially reducing the use of toxic pesticides and herbicides (Brookes and Barfoot, 2016)

**Applications of Plant Genetic Engineering:**

For sustainability and satisfying the demands of the population effective strategies is required to cope with harsh environmental conditions such as water and nutrient stress, high temperatures that substantially reduce crop yield (Davendra, 2012). In agriculture, the genetic engineering is of great interest that helps in introducing tolerance to environmental stresses in crop cultivars to balance the yield under changing environmental conditions such as herbicide resistance, pest resistance, drought, stress and salinity tolerance (Kumar et al., 2020). GM crop Bt cotton and corn are in which the genes from a bacterium are introduced for resistance against pests which therefore, resulted in decreased use of pesticides (Moellenbeck et al., 2001).

In addition, increased nutritive value of crop has come into light to combat malnutrition in developing countries led to production of several transgenic cultivars with fortified nutritive values such as golden rice with increased beta carotene and enhanced Vitamin A content in it (Key et al., 2008). A high quantity of beta carotene which is believed to protect from night blindness, iron and high-level protein potatoes (Ahmed et al., 2011). Many GM crops include maize with high methionine concentration, canola with high lysine amount and soybean plant with enhanced protein content (Muntaha et al., 2016).

**Future Prospects of genetic engineering:**
Genetic engineering has made a tremendous effort since years as many plant species were engineered with improved characteristics (Dalal et al., 2006). With its great success, this technique also faces some of the challenges in assessing gene transfer in transgenics and the major obstacle is gene silencing, which decreases and suppress the expression of gene of interest introduced in the host organism may be due to hypermethylation of incorporated gene (Stam et al., 1997). So, for this reason it is always advised that only a single copy of gene of interest should be introduced inside the genome rather than its multiple copies (Kumar, 2001).

References:


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