

Agriculture and Biotechnology

January 21, 2021

With the world population expected to top nine billion people by 2050, it is critical to create and implement sustainable agricultural practices and technologies. Farmers will have to produce about 70% more food on less land. Using modern biotechnology to grow more productive and nutritious crops is essential for meeting the growing needs of both farmers and consumers.

In news: Year Ender 2020- Achievements of Department of Biotechnology (DBT)

Placing it in syllabus: Science & Technology

Dimensions:

- Biotechnology and seeds
- Pest control and management
- Livestock and diseases
- Future potential

Content

Biotechnology and Seeds:

- Seed is a basic input in agriculture. Seeds have been the crucial factor in the establishment, diversification and improvement of crops.
- Better the seed, better will be the crop produce. Response of other inputs in crop production largely depends on the quality of seed material used.
- Farmers have manipulated plants and animals through **selective breeding** for decades of thousands of years in order to create desired traits.
- **Agricultural biotechnology quickens this process** through the selection of traits like the increased yield, pest resistance, drought resistance, and herbicide

resistance.

- It uses scientific tools and techniques, including genetic engineering, molecular markers, molecular diagnostics, vaccines, and tissue culture.
- The **Department of Biotechnology** has made tremendous efforts in promoting Bioscience research, translational education and entrepreneurship.
- Mission mode programme on “**Minor Oilseeds of India Origin**” in various crops was launched which is aimed at sequencing/re-sequencing and phenotypic characterization of available germplasm resources of Minor Oilseeds (Sesame, Linseed, Safflower and Niger) in the country along with exotic lines from diverse agro climatic regions & elite lines of International Institutes.
- Mission mode programme on “**Characterization of Genetic Resources**” in various crops was initiated for sequencing/re-sequencing and phenotypic characterization of available germplasm resources of Chickpea in country along with exotic lines from diverse agro climatic regions & elite lines of International Institutes has been supported.
- “**India-UK crop science fellowship (INcrops)**” was launched to create a skill set of trained manpower in cutting edge technologies in crop sciences. It is aimed to send ten (10) post-doctoral fellows per year to the UK institutions.
- DBT-NGGF “**National Genotyping and Genomics Facility (NGGF)**” a “single-window service system” for advanced genomics technology services was established to offer affordable and competitive genotyping and genomics services to Public and Private Institutions. Crop breeding companies and seed companies (205) involved in the regular breeding process and activities will be a source of revenue for this facility.
- Three **improved maize hybrids** have been developed by Enrichment of Nutritional Quality in Maize through Molecular Breeding.

- **Pusa HM4 Improved:** has been released and notified for North Western Plain Zone.
- **Pusa HM8 Improved:** has been released and notified for Peninsular Zone [Maharashtra, Karnataka, Andhra Pradesh, Telangana & Tamil Nadu]
- **Pusa HM9 Improved:** has been released and notified for North Eastern Plain Zone [Bihar, Jharkhand, Odisha, West Bengal & Eastern Uttar Pradesh].

Biotechnology Industry Research Assistance Council (BIRAC), established under the Department of Biotechnology in 2012, continues to play a crucial role in the development of the biotech sector in India. BIRAC brings innovators and funders on to a common table, enabling ideas to become a reality and facilitate technological advances that make human progress possible.

Pest Control and Management:

- Scientists and world leaders believe that crop biotechnology holds the key to food security and poverty reduction in the developing world.
- With **GM crops**, genes that confer certain traits are inserted into existing varieties and modify their genetic content. For example, a gene may provide resistance to a disease or enhance the nutritional value of a crop.
- **Genetically Modified (GM) crops** tend to increase crop productivity primarily where pest pressure is high and existing pest control treatments are losing effectiveness.
- **Bt cotton**, which protects cotton against key damaging insects, is **India's first and only commercially approved biotech crop**.
- Cotton in India is grown under more humid conditions than in the US, and is likely to suffer severe pest pressure.

- From farmers' perspective, adoption of GM varieties is simpler and less dangerous than the adoption of toxic chemicals to control pests.
- Multiple studies have attributed between **30-60 per cent increases in cotton yields in India** to the adoption of GM varieties
- GM varieties provide new means to increase crop productivity and are essential in the transition to a renewable, bio-based economy.

Livestock and Diseases:

- Various biotechnology methods are used in improving the breeding stock of animals.
- These include **artificial insemination (AI), embryo transfer (ET), in-vitro fertilization (IVF), and somatic cell nuclear transfer.**
- Biotechnology has allowed the scientists to detect defective genes which cause infection in animals before they are bred.
- Many **DNA tests** are now available through which **inherited weaknesses** can be detected in cattle. Some conditions which are identified by this test are **Leukocyte Adhesion Deficiency (LAD)** and Factor 13 Deficiency.
- Another advantage is the development of the vaccines. These vaccines act against the diseases and help them cure.
- Vaccines developed through biotechnology techniques are more effective and cure disease within less time than the traditional vaccines.
- Genetically developed vaccines stay stable at room temperature and they do not need refrigerated storage.

Recent initiatives of Department of Biotechnology in animal biotechnology:

- Developed a **urine based early pregnancy diagnostic kit** for cattle and buffalo.

- **Consortium for One Health to address Zoonotic and Transboundary Diseases in India** was established to contribute to (a) the availability of state-wise and nation-wide data on the selected zoonotic diseases and transboundary animal diseases (TADs)
- **Genomics for conservation of indigenous cattle breeds and for enhancing milk yield:** The whole genome sequencing data of 176 animals was generated for five major breeds – Gir, Tharparkar, Kankrej, Red Sindhi and Sahiwal. The draft genome sequence for 4 major milch breeds (Gir, Sahiwal, Tharparkar & Kankrej) has been assembled.
- A **whole virus vaccine against nodavirus of fish** was produced using seabass kidney and grouper eye cell lines.
- **Nano-Immuno Rapid Test** to detect Mycobacterium avium subspecies paratuberculosis in milk samples
- New method of diagnosis of **Johne's disease** in the domestic live stocks

Future potential:

- Biotechnology occupies a **strategic position in the socio-economic advancement** and development of Indian agriculture.
- The **favourable location of the biotech hubs** will be crucial. It depends on critical factors like research and technology development competence, market, industry policies, infrastructure, investments.
- The Government needs to harness the potential of biotechnology through innovative initiatives like **Biotech-Kisan**
- To mitigate the effects of climate change, biotechnology needs to be used to develop **Climate-resilient crops** that can sustain in adverse climatic conditions.
- Biotechnology has a place in ensuring **Swasth Bharat, Swachh Bharat, Start-up India, Make in India and Digital**

India.

- The challenge for mitigation of **COVID Pandemic** by supporting vaccines, therapeutics, diagnostics, genomics, biorepositories and a **National Platform (NBRIC)** for achievement of **Atma Nirbharta**.

Mould your thought: How can biotechnology enhance efficiency, productivity and cost-effectiveness in the areas of agriculture? Give evidence from recent achievements of the Department of Biotechnology (DBT).

Approach to the answer:

- Introduction
- Write about advantages of biotechnology
- Write about recent achievements of DBT
- Way forward
- Conclusion