BIOPHARMING: A BOOM FOR MAKING PLANTS INTO FACTORIES

Pooja Kanwar Shekhawat[1], Nikki Kumari[2]
Department of Plant Breeding and Genetics, Sri Karan Narendra Agriculture University, Jobner
Department of Genetics, Indian Agricultural Research Institute, New Delhi

INTRODUCTION:

Biopharming is an appliance of biotechnology in which genetic engineering is used to create plants that can turn out pharmaceutical proteins and chemicals. The proteins and molecules can then be harvested followed by production of pharmaceuticals known as molecular farming. Recombinant proteins or their metabolic byproducts are the end results of pharming. Human serum albumin, the first recombinant plant-derived protein (PDP), was created in 1990 in transgenic tobacco and potato plant. Large-scale production of pharmaceutical chemicals and other powerful (effective) physiologically active molecules can be accomplished more affordably through biopharming. Corn is the most trendy substrate plant for biopharming, followed by soybeans, tobacco and rice. Opium (*Papaver somniferum*) alkaloids, digioxin (*Digitalis species*), rauvolfin and reserpine (*Rauvolfia serpentina*), vincristine (*Catharanthus roseus, Vinca rosea*), placitaxel (*Taxus species*), camptothecin (*Camptotheca acuminata* and *Nothopodytes nimmoniana*), etc., are just a few examples of the drugs that extracted from wild or cultivated non-edible plant species. The cultivated edible plant species provide bioactive substances as piperine (*Piper nigrum*), curcumin (*Curcuma domestica, Curcuma longa*), papain (*Carica papaya*), bromelin (*Ananas comosus*), etc.

Potential of plants as sources of drugs

The majority of significant medications originate from plants, then a small number from animals. Currently, roughly 25% of medicines are made from plants in wealthy nations, compared to more than 75% in developing nations. Transgenic crop biopharming can increase the variety and efficacy of plant-based medicines.

Drug development

Synthesis of natural products depends on different factors, It may be improbable (digioxin), or uncertain in effectiveness (vincristine) or may be too time consuming and expensive (quinine). Generally, To create new chemical structures for medication development, phytochemical, pharmacological, and clinical studies on medicinal plants are needed to confirm the efficacy of their suggested traditional usage. Additionally, this type of study is necessary to increase public trust and encourage the use of plant-based medicines around the world.

Ethnopharmacology

The field of ethnopharmacology is where traditional uses of therapeutic plants are confirmed scientifically. The plant *Rauvolfia serpentina* is the source of the a*lkaloids rauvolfine* and *reserpine*, which lower blood pressure. Picrorrhiza kurrooa is a well-known hepatoprotective herb that contains *picrorrhizine*. The neem tree, *Azadirachta indica*, has more than 120 compounds with antiviral, antimicrobial, and insecticidal characteristics, and numerous others encourage widespread acceptance of herbal remedies.

Anti-cancer drugs from plants

Vincristine, vinblastine, and vindesine are available from *Catharanthus roseus* and are used to treat solid and haematological cancers.

Diagnostic chemicals from plants

In addition, plants offer lectins, which are useful in human and animal blood typing methods. The sole way to distinguish between

blood from the human A1 subgroup and the A2 subgroup in horse gramme (*Macrotyloma uniflorum, Dolichos biflorus*) is through the seed lectin. Only plant lectins, one of which is from Ulex europeus, can distinguish the uncommon blood type known as the Bombay group. Ricin, a lectin found in castor beans (*Ricinus communis*), is used to identify cervical cancer. Lung, prostate, and endometrial malignancies can all be identified by the horse gramme lectin. Colon cancer is detected using the lectin from pea nuts (*Arachis hypogaea*).

Cultivation of medicinal plants

The cultivation of medicinal plants is essential for their sustainable usage and protection, as well as to supply the industry with the necessary amount of raw materials and to satisfy the significant export demand for many species.

Alternatives to cultivation of medicinal plants

Alternative methods of growing medicinal plants include callus culture, suspension cell culture, and bioreactor fermentation.

Genetically engineered crop plants in biopharming

Existing crop plants used as biopharmaceutical transgenics make large-scale production easier and do not necessitate new cultivation techniques.

FUNCTIONAL PROTOTYPES OF TRANSGENIC CROPS WITH THERAPEUTIC POTENTIAL

- **Transgenic rice:** a) b-carotene (Golden Rice), b) human milk proteins, c) higher iron content, d) higher content of zinc, e) low phytic acid and f) high phytase.
- **Transgenic potato:** a) gene from grain amaranth for high protein content, b) antigens of cholera and diarrhoeal pathogens and c) hepatitis B vaccine.
- **Transgenic maize:** a) AIDS antigens, b) higher content of lysine and tryptophan and c) nutritive value equivalent to that of milk.
- **Transgenic fruits and vegetables:** a) Bananas, melons, brinjals and tomatoes with subunit vaccines against Rabies, b) AIDS antigens in tomato and c) human glycoprotein in tomato to inhibit Helicobacter pylorii against ulcers and stomach cancer.

- **Transgenic tobacco:** a) Human haemoglobin, b) human collagen, c) human antibody against Hepatitis B virus and d) 50 per cent lower nicotine.
- **GE coffee:** Decaffeinated by gene silencing.

The transgenic varieties have to pass through the biosecurity regulatory process before commercial cultivation can be taken up.

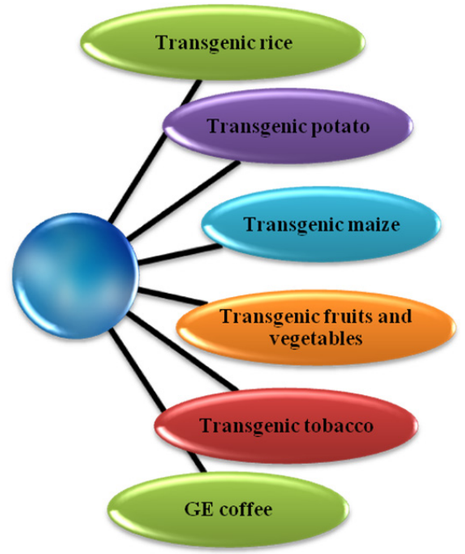

Fig: Functional prototypes of transgenic crops

Segregation of biopharm crops from non-pharma crops

To differentiate transgenic pharmaceutical seed from non-pharma seed, one method is Kernel Visual Distinguishability (KVD) through colour markers. To reduce the risk to non-target populations, genes for toxic bioproducts are placed into non-food crops like jute, sunn-hemp, flax, tobacco, etc. to make segregation easier and prevent unintentional mixing.

Biosecurity concerns

The same biosecurity regulatory procedures that apply to the corresponding transgenic non-biopharm crop kinds would also apply to biopharm crops. The efficacy and safety of the therapeutic products they contain will also be regulated. However, anti-tech groups are likely to mount a stronger resistance against biopharm crops.

CONCLUSION:

Despite the existing prototypes, biopharming is now a concept under development. Before any of these products are available on the market, a significant amount of time would pass.

However, it is a very practical and alluring idea to use biopharming to quickly and cheaply generate medicines, vaccines, and antibodies in domesticated animals and crop plants.