

Genetic Control

Transgenic Plants

Insect Sterility

Transgenic Plants (Genetically modified or GM crops)

- contains a gene or genes which have been **artificially inserted** instead of a plant acquiring them naturally
- Produce **insecticidal or antifeedant proteins** continuously under field conditions enough to kill target pests
- **Bacillus thuringensis and cowpea trypsin protease inhibitors** are ideal to impart resistance to insect attack
- B.t a gram positive soil bacterium, upon sporulation forms a **parasporal crystal proteins** called **delta endotoxins**
- The cry proteins have **selective toxicity to certain pests** and has to be **ingested** by the target insects
- Requires an **alkaline pH of 9.5** or above for effective processing into an active molecule
- Toxins binds to midgut and **creates pores in the intestinal lining** resulting in ion imbalance , paralysis

To develop a B.t transgenic plant,

- Selection of strain of B.t
- Identify the genome
- Isolation of genes (Cry genes, Cry1A, Cry1Ac & Cry3Ab)
- Introduction into plants through genetic engineering methods

- Transgenic technology can be utilized to develop plants with various beneficial traits such as
 - a) Crop protection traits
 - b) Abiotic stress resistance traits
 - c) Quality traits

In India, **Genetic Engineering Approval Committee (GEAC), Ministry of Environment and Forests, Govt of India**, at its **32nd** meeting held in New Delhi on 26th March 2002 approved **three Bt-cotton hybrids** for commercial cultivation

These transgenic hybrids were developed by **MAHYCO** (Maharashtra Hybrid Seed Company Limited) in collaboration with **Monsanto**

Genetic Insect Control

- The basic principle is to utilize factors which will lead to **reproductive failure**
- Includes the use of sterile insects by radiation or chemicals, cytoplasmic incompatibility, induced sterility, hybrid sterility

A) Induced Sterility

i) Sterile male release technique:

- Adequate number of vigorous and competitive sterile males is introduced systematically into natural population
- The population will soon cease to exist
- Theory of Male Sterile Technique was conceived by E F Knipling as early as 1937 and was published in 1955
- He suggested two procedures,

1) **Rearing, Sterilization and Release** (@ 9:1 sterile to fertile insects) of sterile insects to compete with normal population

2) Sterilizing a portion of the natural population

Eg: **Screw-worm** (*Cochliomyia hominivorax*) a cattle pest was completely eradicated from Curacao Islands and south eastern parts of USA by male sterilization by irradiation with gamma rays (Co60)

Limitation: Applicable only to species, where the **female mates only once in its lifetime**

ii) **Aspermia:** Inactivation of sperms

- In mosquitoes the sperm of the incompatible male is **blocked before fertilization**
- employed in eradicating **Culix pipens quinquefasciatus** in Rangoon
- incompatible strain could be identified, multiplied in large numbers and released in infested areas

iii) **Infecundity:** Sterile eggs by dominant lethal mutations

iv) **Use of non-mutagenic chemicals:** To induce sterility by preventing mating by **developing monogamous females, inhibition of spermatogenesis** or by sperm inactivation

B) Cytoplasmic Incompatibility

- A **cytoplasmic factor** transmitted through the egg
- kills the sperm of incompatible male after its entry into the egg
- Crosses between these populations give no off-spring at all
- Females of one population may cross with males of other and off-spring are produced
- but the reciprocal cross is completely sterile
- When males of one such strain mate with females of another strain, the offspring fails to develop because of incompatibility between the genes of the egg and the sperm

C) Hybrid Sterility:

- In some insect cross-types or races, produce fertile females but sterile males among progeny
- These sterile males are more vigorous and competitive than the fertile males

D) Population Replacement:

- The ability of disease transmission of vectors can as well be changed by genetic methods

E) Auto-Sterilization:

- Sterilization of native insects in their natural environment by using chemosterilants along with the species specific attractants / lures/ bait traps
- Through this both the sexes can be sterilized, and also negate the reproductive ability of those insects which have escaped the lure/bait treatment