

### Lecture 30 : BIOTECHNOLOGY IN PEST MANAGEMENT

Use of molecular biology techniques for the management of insect pests. The following are some strategies.

1. **Wide hybridization:** This technique involves transfer of genes from one species to other by conventional breeding. The genes for resistance are transferred from a different species. e.g. WBPH resistant gene has been transferred to *Oryza sativa* from *O.officinalis*.
2. **Somaclonal variability:** The variation observed in tissue culture derived progeny. e.g. Somaclonal variants of sorghum resistant to *Spodoptera litura* has been evolved.
3. **Transgenic plants:** Transgenic plants are plants which possess one or more additional genes. This is achieved by cloning additional genes into the plant genome by genetic engineering techniques. The added genes impart resistance to pests.

Transgenic plants have been produced by addition of one or more following genes.

- a. Bt endotoxin from *Bacillus thuringiensis*
- b. Protease inhibitors
- c. -Amylase inhibitors
- d. Lectins
- e. Enzymes

- c. **Bt endotoxin gene:** The gram positive bacteria *Bacillus thuringiensis* produces a crystal toxin called (delta) endotoxin.  
The endotoxin is a stomach poison and kills the lepidopteran insects if consumed.

The gene (DNA fragment) responsible for producing endotoxin is isolated from Bt and cloned into plants like cotton, potato, maize, etc. to produce Transgenic cotton, etc.

#### Transgenic Bt plants

1. Cotton
2. Maize
3. Rice
4. Tobacco, Tomato
5. Potato, Egg plant

#### Target insect pests

- Bollworms, *S. litura*  
European corn borer  
Leaf folder, stem borer  
Cut worms  
Colorado potato beetle

**b. Protease inhibitors (PI) gene**

Insects have proteases in their gut which are enzymes helping in digestion of protein. Protease inhibitors are substances inhibit the proteases and affect digestion in insects. The protease inhibitor gene are isolated from one plant and cloned into another to produce transgenic plants.

e.g. Transgenic apple, rice, tobacco containing PI. e

e.g. Cowpea trypsin inhibitor (CpTI) is a PI isolated from cowpea and cloned into tobacco. This transgenic tobacco is resistant to *Heliothis virescens*.

**c. -Amylase inhibitor gene**

-Amylase is a digestive enzyme present in insects for digestion of carbohydrate. -Amylase inhibitor, affect digestion in insects.

Transgenic tobacco and tomato expressing -amylase inhibitor have been produced which are resistant to Lepidopteran pests.

**d. Lectins genes**

Lectins are proteins that bind to carbohydrates. When insect feed on lectins, it binds to chitin in peritrophic membrane of midgut and prevents uptake of nutrients. e.g.

Transgenic tobacco containing pea lectin gene is resistant to *H. virescens*

**e. Enzyme genes**

Chitinase enzyme gene, and cholesterol oxidase gene have been cloned into plants and these show insecticidal properties.

**PYRAMIDING GENES**

Engineering transgenic crops with more than one gene to get multi-mechanistic resistance is called pyramiding of genes. e.g.

1. The CpTi gene and pea lectin gene were cloned to produce a transgenic tobacco.
2. Transgenic potato which express lectin and bean chitinase have been produced.

**Potentials/Advantages of Biotechnology in IPM**

1. Slow development of resistance against transgenic Bt, PI, lectins
2. All plant parts express toxin and so no need for insecticide spray
3. No need for continuous monitoring
4. No environmental pollution, safe to NE, non-target organism