

and combined with (2) Pathogen driven gene.

↳ Antimicrobial compound gene  
 so <sup>resistance</sup> it is effective and broad.

Example:

- 1- When they take a tobacco plant and insert tobacco gene of a resistant variety and also combine gene from Tobacco vein mottling virus is also inserted then the plant become resistant to potyviruses.
- 2- They insert a Tomato (N) gene in Tomato plant + a SW5 gene (tomato spotted wilt virus) then tomato plant become resistant to many strains of virus.
- 3- If you take Rice plant & insert a gene of maize + Rice gene from a resistant gene then plant become resistant against Rice blast + show tolerance against i) Submergence ii) Salt tolerance +  $H_2O_2$  (Hydrogen peroxide) tolerance.

⇒ Transgenic Plants producing Antibodies against Pathogen.

→ when Fab fragment (single chain Fv or ScFv) gene is inserted in plant, then antibodies are produced in plants in all body of plant so this is called Plantibodies.

⇒ Success Stories (Examples)

- 1) Tobacco Mosaic Virus
  - 2) Potato Virus X
  - 3) Potato Virus Y
  - 4) Clover yellow vein virus.
- (Antibodies are ~~control~~ produced against these viruses).

⇒ Control Through Use of Transgenic biocontrol microorganisms & Antagonists

How Biocontrol agents control diseases?

By producing through i) Toxin ii) Enzyme secretion. These are actually antagonists & compete with pathogenic fungus and pathogens.

Through genetic engineering genome of Biocontrol agents were changed so that these BCA's produce more enzymes & toxins against the target pathogenic fungus.

Also reproduction rate & growth rate is increased by these changes so it competes better with pathogen.

→ Direct Protection of Plants from Pathogen

By direct protecting plants by using chemical systemic, contact fungicides & by using BCA's

→ Apple Scab (Venturia inaequalis) are endemic in nature.

→ Some diseases are annual like Rusts so these diseases are controlled directly.

i) Direct Protection by using Biocontrol  
 BCAs directly kill the pathogen or compete with them with food, nutrition & water & space.

BCAs can be of Fungal source or Bacterial sources:-

i) Fungal:-

\* Gliocladium virens (Gliocard) GT control seedling diseases of beds & ornamental plants

\* Trichoderma harzianum (F-stop) GT effective against soil borne pathogens.

\* Trichoderma polysporum (BINAB), effective against wood decay.

ii) Bacterial:

\* Agrobacterium radiobacter (K-84) (Galex or Galltrol) & effective against Crown Gall

\* Pseudomonas fluorescence (Dagger)

and effective against Pythium causing cotton seedling damping off disease & also against Rhizoctonia.

\* Bacillus subtilis (Kodiak <sup>Trade name</sup>) & effective against seed borne diseases.

⇒ Success stories: (examples)

→ In fungal antagonists a fungus

Phlebiopsis gigantea & this fungus