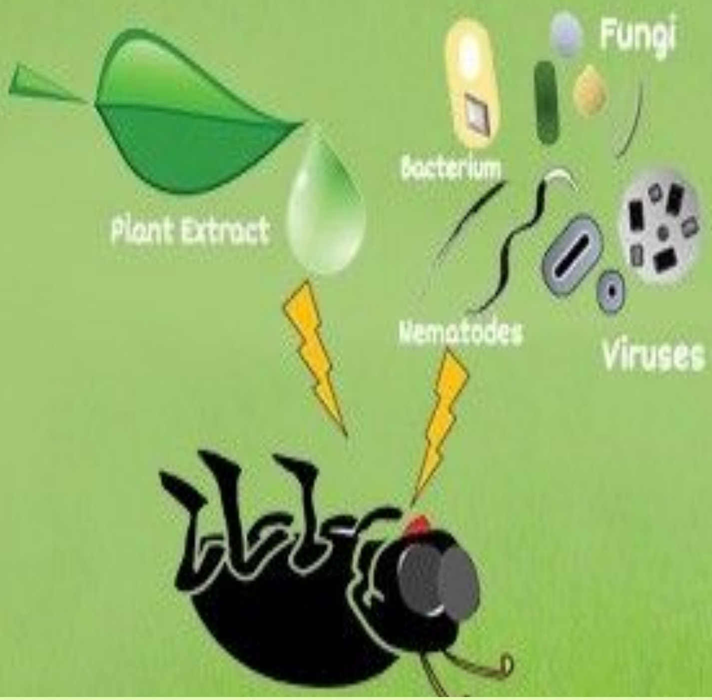
Bacillus thuringiensis: its characteristics and application.



 Importance of Bacillus spp. (Bacillus thuringiensis) – its characteristics and application.

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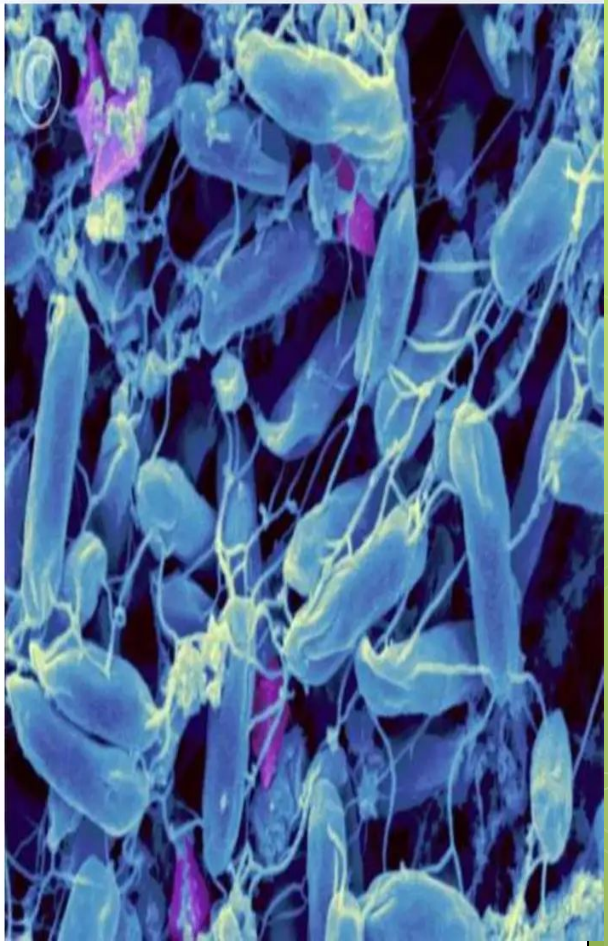
Bacillus thuringiensis

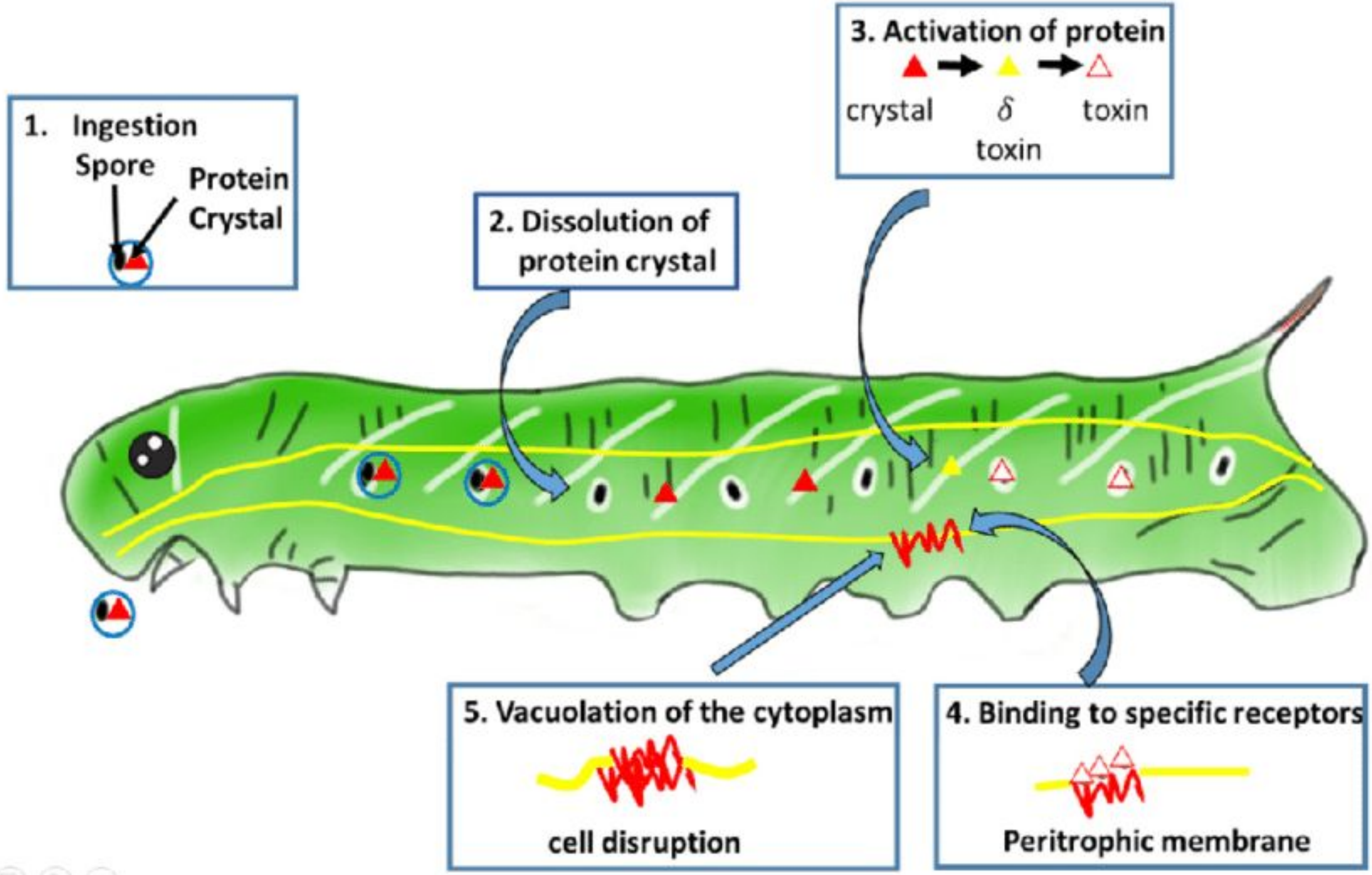
- Shigetane Ishiwatari (1901), first isolated ***Bacillus thuringiensis*.**
- ***Bt*** **is commonly abbreviated as *Bacillus thuringiensis*, is a gram-positive, facultative aerobic, rod-like, motile and sporulating bacterium.**
- **Bt is a naturally-occurring soil borne bacterium that is found worldwide**
- **Ubiquitous in nature.**
- **Produces crystals of endotoxin (*Cry* protien or delta toxin) - toxic to insect mainly in their larval stage, thus they act as insecticides.**

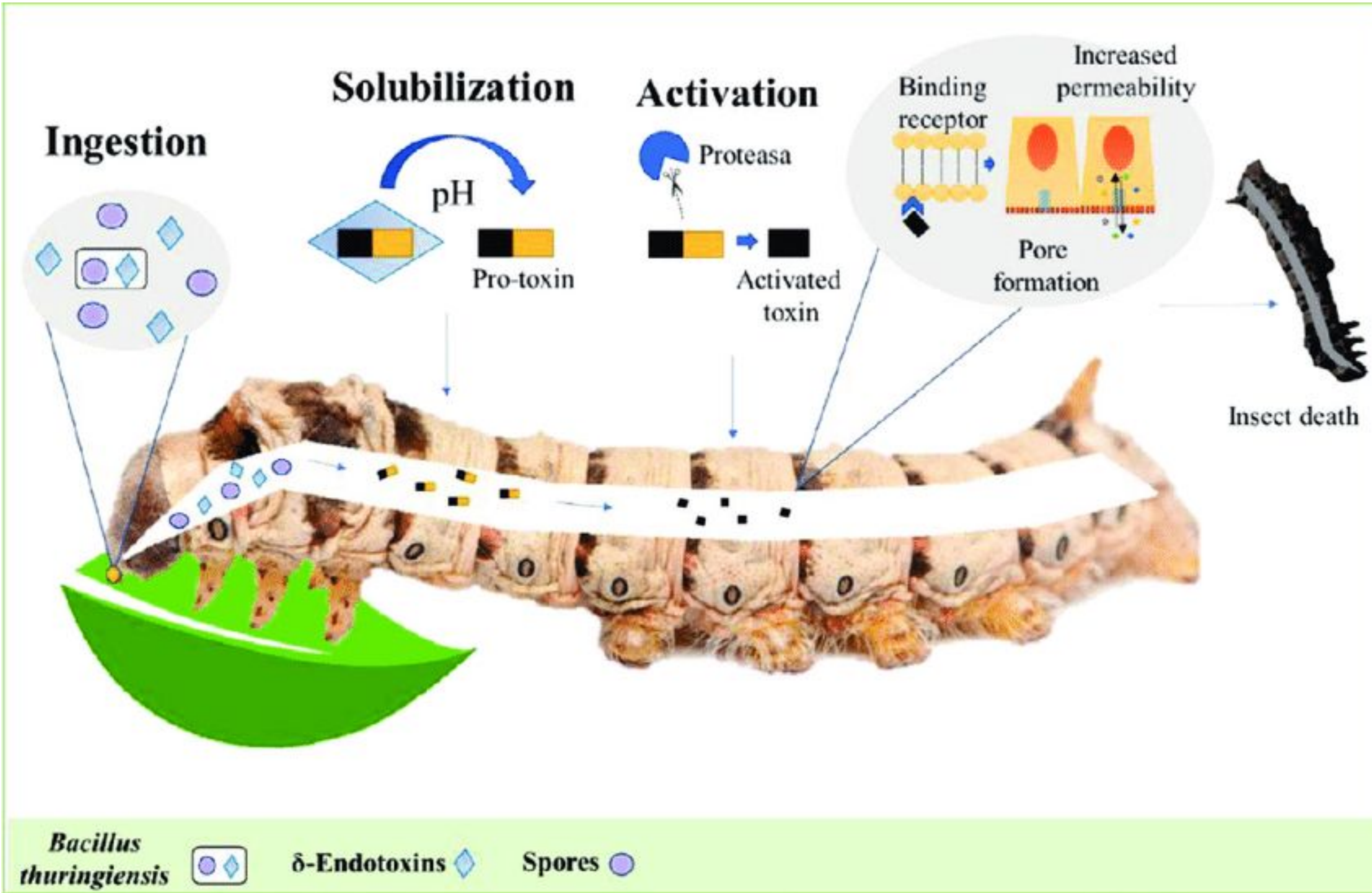


- These crystal proteins (Cry proteins) are insect stomach poisons
- Insects stop feeding within two hours of a first bite and, if enough toxin is eaten, die within two or three days
- Important biological insect control agent.
- *Bt* crystals, sometimes referred as insecticidal crystal proteins (ICP), are protein crystals formed during sporulation in some *Bt* strains coded by *cry* genes.

What is Bt cotton ?

- Genetically modified variety of cotton that produces an insecticide.
- Marketed by Monsanto, USA.


1. Ingestion
Spore
Protein
Crystal
2. Dissolution of
protein crystal
3. Activation of protein
crystal
δ
toxin
toxin
5. Vacuolation of the cytoplasm
cell disruption
4. Binding to specific receptors
Peritrophic membrane


Ingestion
Solubilization
pH
Pro-toxin
Activation
Proteasa
Activated toxin
Binding receptor
Increased permeability
Pore formation
Insect death
Bacillus thuringiensis
δ-Endotoxins
Spores

MODE OF ACTION OF *Bt*.

1. pH requirement of alkaline condition.
2. Release of toxin
    1. Solubilisation of toxins by breaking the disulphide linkages
    2. Activation of protoxin to active toxin
3. Binding of active toxin to BBMV's receptors mainly *cadherins, APN, ALP, GPI* (glycosylated phosphotidyl inositol) of midgut epithelial cells.
4. Formation of pores in cell membrane (two models are proposed)
    1. Penknife model.
    2. Umbrella model.
5. Cell lysis (two theories are proposed)
    1. Proton Perill theory
    2. Osmotic cell lysis theory.

Advantages of Bt-cotton

- Yield superiority
- More profit
- Lesser need of pesticide
- Better quality
- Suitability for early sowing

DISADVANTAGES

- *Higher cost of seeds*
- *Higher fertilizer and irrigation cost*

Applications of Bacillus thuringiensis:

- **Insect Pest Control:** Bt is commonly used to control a wide range of insect pests in agriculture, forestry, and horticulture. It is particularly effective against caterpillars, such as those that attack crops like corn, cotton, and soybeans. Bt insecticides are considered environmentally
- **Organic Farming:** Bt is an important tool in organic farming practices. Organic growers use Bt sprays to manage insect pests without resorting to synthetic chemical pesticides.
- **Genetically Modified Crops:** Bt genes have been incorporated into the genetic makeup of certain crops, creating genetically modified organisms (GMOs) known as Bt crops. The most famous example is Bt cotton.
- **Forest Pest Control**: Bt is used to combat pests that affect forests, such as the gypsy moth and spruce budworm. It can be sprayed aerially over large forested areas to protect valuable timber resources.
- **Mosquito Control:** Some strains of Bacillus thuringiensis subspecies israelensis (Bti) are used in the control of mosquito larvae in stagnant water bodies. This helps reduce the spread of mosquito-borne diseases like malaria and dengue fever.
- **Environmental Conservation:** Bt-based products can be used for the control of invasive insect species in natural habitats to protect native flora and fauna.
- **Biological Control:** In addition to direct applications, Bt is sometimes used as a component of integrated pest management (IPM) strategies, where it complements other control methods like beneficial insects and crop rotation.

DIFFERENCE BETWEEN BT COTTON AND COTTON

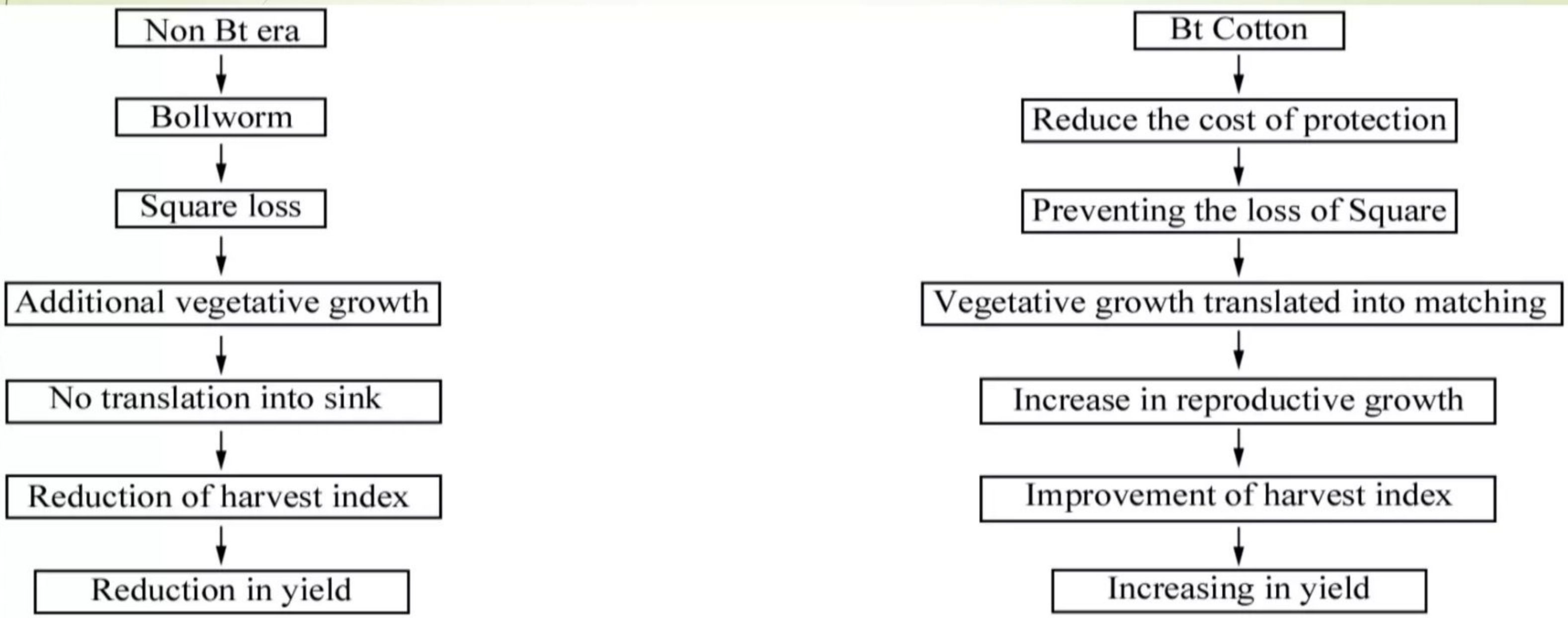
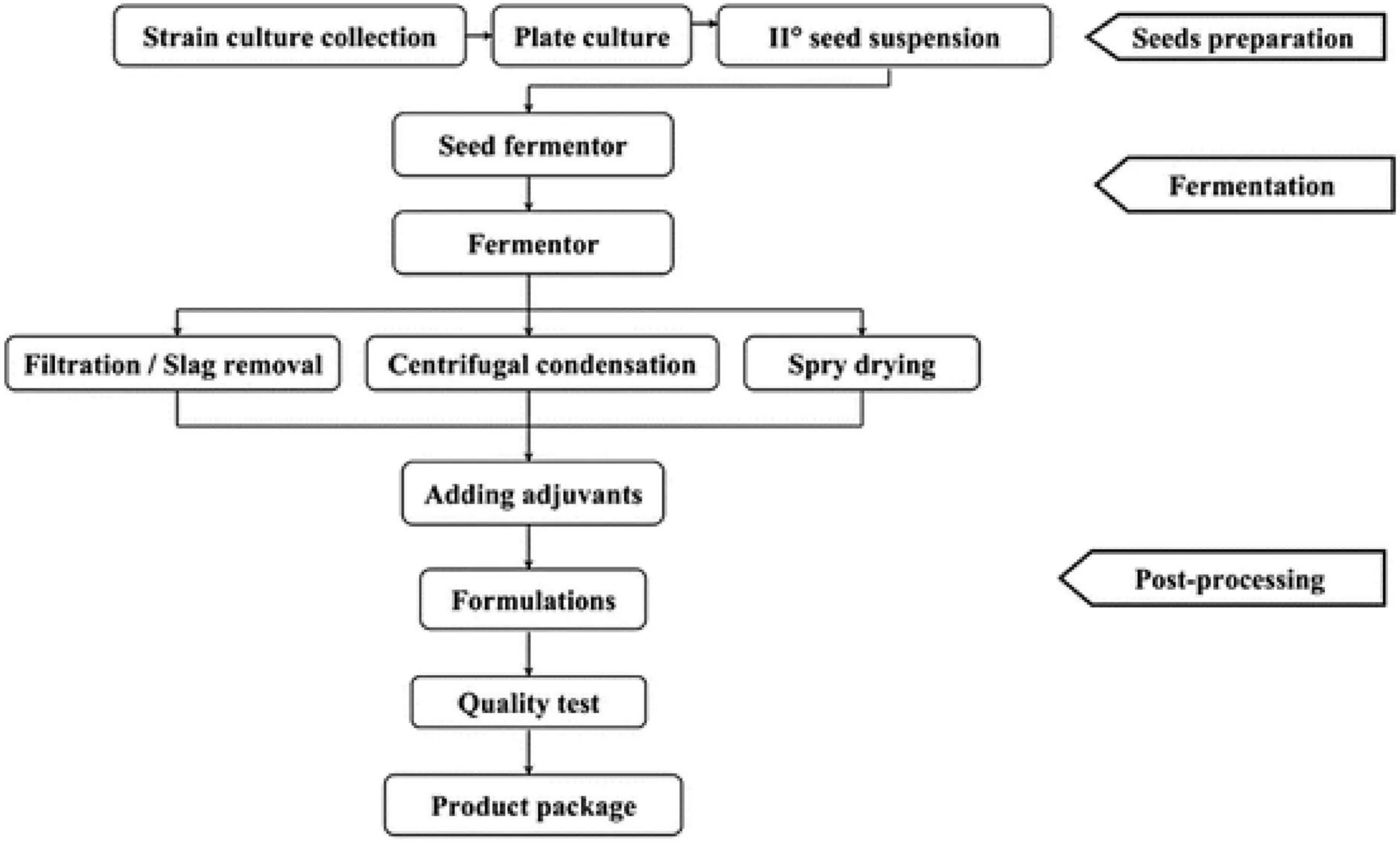


Figure 1 Comparison between Bt cotton and non Bt cotton

✷Let us nurture the nature for our future by ECO- SUSTAINABLE AGRICULTURE Using Bio-control

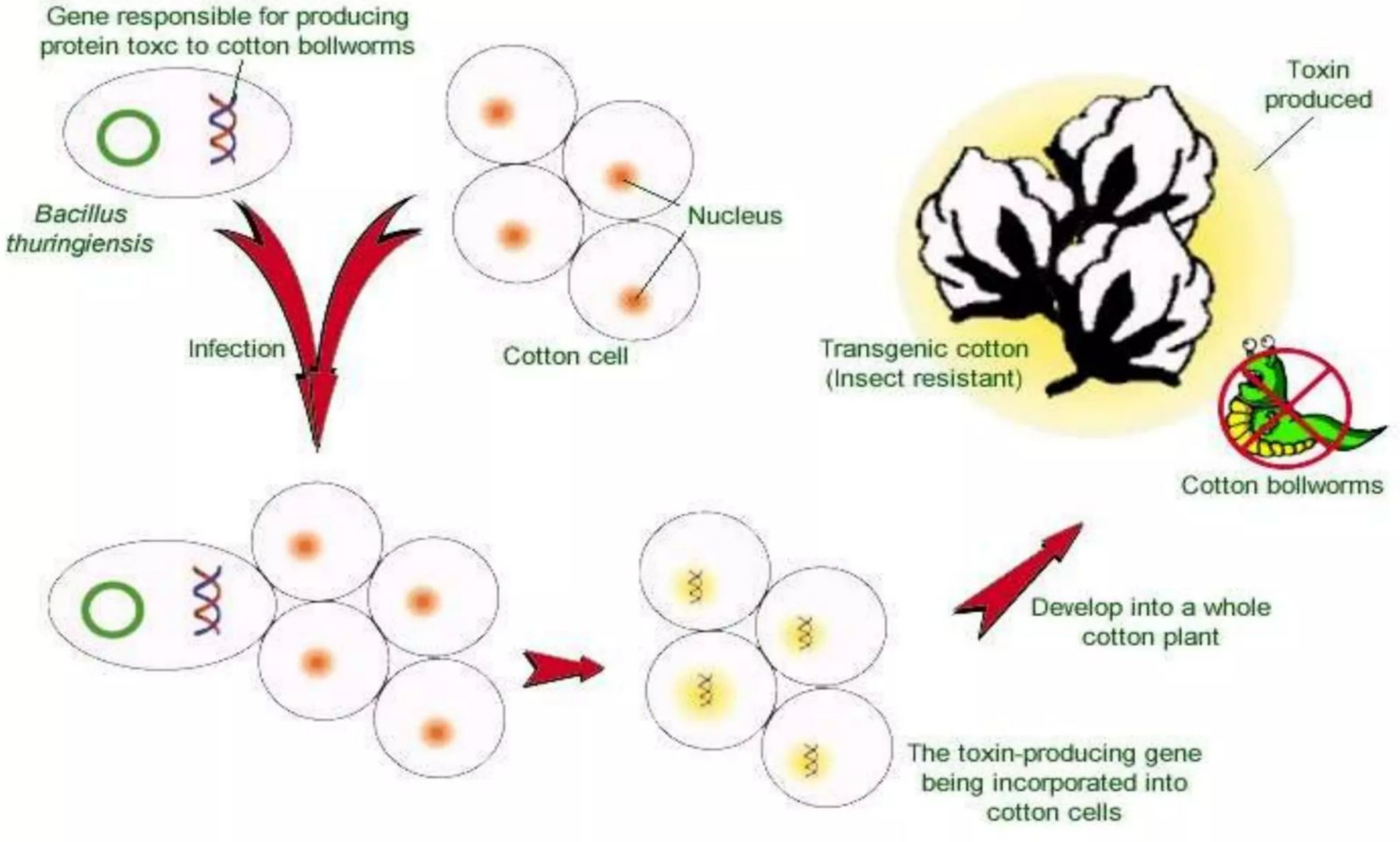
THANK YOU

MANUFACTURING PROCESS



Flow chart 01 : Schematic representation of Biopesticide manufacturing process

Production of Bt Cotton



- **RAW MATERIAL**

•May be organic or inorganic compounds

•Different raw material for different pesticide

- **REACTOR SYSTEM**

•Chemical process takes place in the presence of chemicals such as oxidation, nitration, condensation, etc.

- **FRACTIONATION SYSTEM**

•Separation process in which certain quantity of a mixture (solid, liquid, solute, suspension or isotope) is divided up in a number of smaller fractions in which composition change

•Recovery

- **DRYER**

•Removal of water or other solvent by evaporation from solid, semi-solid or liquid

•Final production step before selling or packaging products.

- **SCRUBBERS**

•To remove priority pollutants from pesticide product using scrubbing liquor

•Wastewater go to treatment plant

- **PACKAGING**

•Packed in dry and clean containers e.g., drums type depend on type of pesticide

•Capacity 10,25,50,100,200 litres.

•Temper-proof, closer to avoid leakage, sturdy

- **FORMULATION**

•Processing a pesticide into granules, liquid, dust and powder to improve its properties of storage, handling, application, effectiveness, or safety.

•Dry mixing, grinding of solids, dissolving solids and blending

Mass production of biopesticides

Mass production of biopesticides involves the large-scale cultivation, processing, and formulation of biological agents such as bacteria, fungi, viruses, or natural compounds to control pests, insects, and diseases in agriculture. Biopesticides are considered environmentally friendly alternatives to chemical pesticides, and their production requires specific steps to ensure quality, efficacy, and scalability. Here is an overview of the mass production process for biopesticides:

Strain Selection: The first step in mass production is to select the most effective and virulent strains of the biopesticide agent. These strains should target the specific pest or disease to be controlled.

Laboratory Cultivation: Initial cultures of the selected strains are grown in the laboratory using suitable growth media. This step allows for the propagation of a pure culture of the biopesticide agent.

Fermentation: After the laboratory phase, the biopesticide agent is cultivated in large-scale fermentation tanks or bioreactors. These tanks provide controlled conditions for microbial growth, including temperature, pH, oxygen levels, and nutrient supply. The fermentation process allows for the production of a large biomass of the biopesticide agent.

Harvesting: Once the fermentation process is complete, the biomass containing the biopesticide agent is harvested. This can involve separating the agent from the growth medium using various techniques, such as centrifugation or filtration.

Formulation: The harvested biomass is then formulated into a suitable product, which can vary depending on the type of biopesticide. Formulations may include wettable powders, liquid concentrates, granules, or dusts. The goal is to create a stable and easy-to-apply product.

Quality Control: Quality control tests are conducted to ensure the potency and efficacy of the biopesticide product. These tests assess parameters like the concentration of the active ingredient, viability, and purity of the agent.

Packaging: The final product is packaged in containers that are appropriate for distribution and application. Proper packaging helps protect the product from degradation and ensures safe handling.

Registration and Regulatory Compliance: Biopesticides must often go through a regulatory approval process before they can be sold and used. This process ensures the safety and efficacy of the product. Manufacturers need to provide data on product performance, environmental impact, and safety to regulatory authorities.

Distribution and Application: Once regulatory approvals are obtained, the biopesticides are distributed to farmers and agricultural professionals for use. Proper training and guidance on the application methods are typically provided.

Monitoring and Feedback: Continuous monitoring of product performance in the field is important to assess the effectiveness of the biopesticide. Feedback from users can help refine production processes and formulations.

Research and Development: Ongoing research and development efforts are essential to improve the efficacy and environmental safety of biopesticides, discover new agents, and develop innovative production techniques.

Mass production of biopesticides is a complex and highly regulated process, and it plays a crucial role in sustainable agriculture by reducing the reliance on synthetic chemical pesticides and minimizing their impact on the environment and human health.