

Q.1 : Discuss about Importance of Beneficial Insects.

Ans. : Importance of Beneficial Insects

Beneficial insects are those that provide ecological, agricultural, economic, and environmental services to humans and natural ecosystems. They contribute to pollination, biological control, decomposition, soil fertility, biodiversity maintenance, and production of valuable products. Their role is especially significant in sustainable agriculture and Integrated Pest Management (IPM).

1. Pollination

Pollination is the transfer of pollen from the anther to the stigma, leading to fertilization and seed/fruit formation. Insects are the most important biotic pollinators.

Major Pollinators

- *Apis mellifera*
- *Apis cerana*
- *Bombus terrestris*
- Solitary bees
- Butterflies and moths (Lepidoptera)
- Hoverflies (Diptera)

Ecological Importance

- Approximately 75–80% of flowering plants depend on insect pollination.
- Maintains plant genetic diversity through cross-pollination.
- Ensures reproduction of wild plants, maintaining ecosystem stability.

Agricultural Importance

- Enhances fruit set in crops such as apple, pear, mango, cucurbits, sunflower, mustard, and oilseeds.
- Improves quality parameters such as:
 - Fruit size and weight
 - Seed number
 - Uniformity of shape
 - Oil content in oilseed crops
- Increases crop yield by 20–200% depending on crop and pollinator abundance.

Economic Importance

- Pollination services contribute billions of dollars globally.
- In India, managed bee colonies significantly increase mustard and litchi yield.

Thus, pollinators are essential for food security and nutritional diversity.

2. Biological Control Agents

Biological control involves the suppression of pest populations by natural enemies. Beneficial insects act as predators, parasitoids, and sometimes vectors of pathogens.

A. Predators

Predators consume multiple prey individuals during their lifetime.

Examples:

- *Coccinella septempunctata* – feeds on aphids.
- *Chrysoperla carnea* – feeds on aphids, thrips, whiteflies, mealybugs.
- Dragonflies – prey on mosquitoes.
- Praying mantids – general predators.

Importance:

- Rapid reduction of pest populations.
- Effective against sucking pests.
- Provide long-term suppression in cropping systems.

B. Parasitoids

Parasitoids lay eggs inside or on the host insect; the developing larva kills the host.

Examples:

- *Trichogramma chilonis* – parasitizes lepidopteran eggs.
- Braconid and ichneumonid wasps.

Importance:

- Highly host-specific.
- Effective in preventing pest outbreaks.
- Used in mass release programs in IPM.

C. Role in IPM

- Reduce pesticide dependence.
- Delay pest resistance.
- Maintain ecological balance.
- Environmentally safe and cost-effective.

Biological control agents are key components of sustainable agriculture.

3. Decomposition and Nutrient Recycling

Decomposer insects break down organic matter and recycle nutrients.

Important Groups

- Dung beetles
- Carrion beetles
- Termites
- Fly larvae (maggots)

Functions

- Decompose dead animals and plant residues.
- Accelerate nutrient cycling.
- Convert organic waste into simpler compounds.
- Improve soil fertility.

Termites digest cellulose with the help of symbiotic microorganisms, contributing to carbon cycling.

4. Soil Improvement and Ecosystem Engineering

Certain insects modify soil structure and enhance its physical properties.

Ants and Termites

- Increase soil aeration through tunneling.
- Improve water infiltration.
- Mix soil layers.
- Enhance microbial activity.

Termites are considered ecosystem engineers due to their large-scale soil modification activities.

Soil-dwelling insects improve:

- Soil porosity
- Nutrient availability
- Organic matter decomposition
- Root growth environment

5. Production of Commercial and Industrial Products

Beneficial insects contribute significantly to rural economies and cottage industries.

A. Honey and Beeswax

Produced by **Apis mellifera**

Products:

- Honey (nutritive and medicinal)
- Beeswax (candles, cosmetics, pharmaceuticals)
- Royal jelly
- Propolis
- Bee venom

Beekeeping supports livelihood and pollination-based agriculture.

B. Silk Production

Produced by **Bombyx mori**

Importance:

- Basis of sericulture industry.
- Generates employment in rural areas.
- India is one of the largest silk producers globally.

C. Lac Production

Produced by **Kerria lacca**

Uses:

- Varnishes
- Bangles
- Sealing wax
- Food glazing agent

India is a major producer of lac.

D. Natural Dyes

Obtained from **Dactylopius coccus**

- Used as natural red dye.
- Applied in food and textile industries.

6. Role in Food Chains and Biodiversity Conservation

Beneficial insects:

- Form the base of many food webs.
- Serve as food for birds, reptiles, amphibians, fish, and mammals.
- Maintain trophic interactions.

Loss of beneficial insects may lead to:

- Pest outbreaks
- Reduced pollination
- Ecological imbalance

They are crucial for ecosystem resilience and biodiversity conservation.

7. Scientific and Research Importance

Insects serve as model organisms in research.

Example:

- **Drosophila melanogaster**

Research Applications:

- Genetics
- Developmental biology
- Neurobiology
- Toxicology
- Evolutionary studies

Their short life cycle and ease of culture make them ideal experimental models.

8. Environmental Indicators (Bioindicators)

Certain beneficial insects indicate environmental quality.

- Butterflies indicate habitat health.
- Dragonflies indicate freshwater ecosystem quality.
- Decline in pollinators signals ecological disturbance.

They help monitor:

- Climate change
- Habitat degradation
- Pollution levels

9. Role in Sustainable Agriculture

Beneficial insects:

- Enhance ecological balance.
- Reduce chemical inputs.
- Promote organic farming.
- Improve crop productivity naturally.

Conservation strategies include:

- Reduced pesticide usage.
- Flowering strips and refuges.
- Habitat diversification.
- Conservation biological control.