

BIOLOGICAL CONTROL

- **Defn.**

Biological control refers to the use of natural enemies against a pest population to reduce the pest's density and damage to a level lower than would occur in their absence

Factors affecting bio-control

1. Tolerance limit of crop to insect injury-Successful in crops with high tolerance limit.
2. Crop value-Successful in crops with high economic value

FACOTRS AFFECTING BIO-CONTROL

3. Crop duration-Long duration crops highly susceptible
4. Indigenous or exotic pest-Imported NE more effective against introduced pest.
5. If alternative host available for NE, control of target pest is less.
6. If unfavourable season occurs, reintroduction of NE required.
7. Presence of hyperparasitoids reduces effectiveness of bio-control.

FACTORS AFFECTING BIO-CONTROL

8. Tritrophic interaction of **Plant-Pest-Natural enemy** affects success of biocontrol. For example, *Helicoverpa* parasitization by *Trichogramma* more in tomato than in maize.
9. Use of pesticides affect NEs.
10. Selective insecticides (less toxic to NE required).

QUALITIES OF AN EFFECTIVE BIO-CONTROL AGENT

1. Adaptable to the environmental condition.
2. Host specific (or narrow host range).
3. Multiply faster than the host (with high fecundity).
4. Short-life cycle and high female : male ratio.
5. High host searching capacity.
6. Amenable for easy culturing in laboratory.
7. Dispersal capacity.
8. Free from hyperparasitoids.
9. Synchronize life cycle with host.

TECHNIQUES OF BIO-CONTROL

- **3 types:**

- 1. Conservation and enhancement of indigenous NE**

These are actions that preserve and increase NE by environmental manipulation e.g. Use of selective insecticides, provide alternative host and refugia for NE.

CONSERVATION AND ENHANCEMENT MEASURES

- Protection from pesticides, i.e. judicious use required; decreased dosages; decreased frequency of application; use of selective pesticides
- Resistant or tolerant natural enemies to pesticides
- Preservation of inactive stages of natural enemies, i.e. destruction of overwintering or diapause sites should be avoided
- Avoidance of harmful cultural practices, e.g. burning, mowing
- Maintenance of diversity and necessary hosts. Maintenance of diversity may provide needed hosts, sources of food, overwintering sites, refugia, etc

CONSERVATION AND ENHANCEMENT MEASURES

- Maintenance of alternative hosts
- Encouragement of plants that provide food for the natural enemies, i.e. those that produce flowers for nectar feeders and pollinators
- Provision of artificial food supplements. Artificial honey dew and pollen have been used to induce early oviposition of *Chrysopa* (Lacewing: Neuroptera) and Coccinellids in alfalfa fields, thereby controlling aphids in alfalfa and bollworms in cotton.
- Provision of artificial shelters. Reductions of tobacco hornworms were achieved by predacious *Polistes* wasps following construction of nesting shelters

CONSERVATION AND ENHANCEMENT MEASURES

- Reduction of undesirable predators. Control of the walnut aphid, *Chromaphis juglandicola* by *Trioxys pallidus* has been jeopardized in some areas by the selective predation of parasitized aphids by the Argentine ant, *Iridomyrmex humilis*
- Control of honey dew-feeding ants which interfere with the biological control of honey dew-producing species such as scales, mealybugs and aphids.

TECHNIQUES OF BIO-CONTROL

2. Importation/Introduction/Classical

- Involves importation and colonization of natural enemies against foreign or native pests.
- The imported species may be used to establish a laboratory colony.
- It is best suited for control of pests of perennial crops.

3. Augmentation

Involves the mass-culturing and release of NE to increase its population.

AUGEMENTATION

- **Two types:**
 - i. **Inoculative release:** Control expected from the progeny and subsequent generations only.
 - ii. **Inundative release:** NE mass reared and released to suppress pest directly e.g. *Trichogramma* sp. egg parasitoid, *Chrysoperla carnia* predator.

Inundative release is analogous to pesticide application and is most widely used on annual crops such as fruit, vegetables and weeds

BIO-CONTROL AGENTS

- **Predators** kill their prey by direct attack and an individual may consume many prey individuals. They may hunt their prey on the ground, on vegetation or in flight or may trap by various means. Predators are usually larger than their victims. Examples of groups containing predacious insects are as follows:
 - Syrphidae (Diptera)
 - Reduviidae (Hemiptera)
 - Chrysopidae and Hemerobiidae (Neuroptera)
 - Dermaptera
 - Mantodea (Dictyoptera)
 - Coccinellidae (Coleoptera)
 - Cantharidae (Coleoptera)
 - Carabidae (Coleoptera)

BIO-CONTROL AGENTS

- **Parasites:**

Parasites are usually smaller than the host and the host is not usually killed by a single parasite.

Parasites are often host specific, which enhances their effectiveness in the control of particular pest species.

For example, sucking and biting lice (*Bevicola* spp.) and cattle louse, *Haematopinus eurysternus*.

BIO-CONTROL AGENTS

- **Parasitoids:**

Parasitoids lay their eggs in or on the bodies of other arthropods and develop at the expense of the host, eventually killing it.

Most parasitoids belong to the orders Hymenoptera (90%) and Diptera (10%). Most species of the hymenopteran superfamilies Ichneumonoidea and Chalcidoidea are either parasitoids or hyperparasitoids (parasitoids of parasitoids) attacking the eggs, larvae, pupae, and very rarely adults.

TYPES OF PARASITOIDS

- **Solitary parasitoid:** Occurs where one parasitoid individual normally completes development per host. All other parasitoid individuals get killed by the survivor. Examples are found in Ichneumonids and Tachinids.
- **Gregarious parasitoid:** This occurs where more than one parasitoid individual normally completes development in one host. Examples in Braconid and chalcidoid wasps.

TYPES OF PARASITOIDS

- **Polyembryony:** Occurs where more than one individual parasitoid develops from a single fertilized egg.
- **Hyperparasitoid:** Occurs where a parasitoid attacks other parasitoids.

ADVANTAGES OF BIO-CONTROL

- Pest problems are neither intensified nor new ones created.
- Biological control is safe and non toxic.
- Control agents are natural and there is no need for expensive manufacturing plants.
- Biological control agents can seek out and find the host pest species.
- Biological control agents are self-perpetuating.
- There is no development of resistance against the natural enemy.

DISADVANTAGES OF BIO-CONTROL

- Control is slow.
- It is not exterminant and therefore many farmers do not like it.
- Often unpredictable.
- It is difficult and expensive to develop.
- It requires thorough knowledge of bionomics, ecology, taxonomy, life cycle, and population dynamics.
- It requires expert supervision.

OTHER BIO-CONTROL TOOLS

- Microbial control
- Repellents
- Attractants
- Anti-feedants
- Pheromones
- Sterile male release
- Chemo-sterilants
- Hormones



THINKSTOCK