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Biological Control- An Eco-friendly Tool for Pest Management

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Introduction

The management of a pest utilizing another living organism (pathogens, parasitoids predators, botanical extracts) that is encouraged and disseminated by man is called biological control. In such a program the natural enemies, entomopathogenic fungi, entomopathogenic nematode, and bio-control agents are introduced, encouraged, multiplied byartificial means, and disseminated by a man with his efforts instead of leaving it to nature.Bio pesticide refers introduction of any living organism such as microorganism, parasitoids, predators, botanicals, biochemical, etc that controls pests by biological non-toxic means e.g., *Bacillus thuringiensis*, *Beauveria*, NPV, EPN, *Trichogramma*, Hormones,etc, Due to using to chemically synthesized pesticides, it is deteriorating the soil health and environment in appreciable amount. A permanent solution is needed to tackle these problems, and the key to all this is the use of biological control methods.

Natural Enemies.

Deliberately introduction and establishmentof natural enemies to a new area where they did not occur or originate naturally. After the establishment of naturalenemies, they successfully continue to control the pest population. It is also released by Augmentation or Conservation approaches.

i. **Parasitoids:** It is an insect parasite of an arthropod, parasitizesimmature stages, destroys itshost in the process of development, and free-living as an adult. Example:*Centrococcus isolitus*on brinjal, *Pulvinaria psidi* on guava and sapota, *Meconellicoccushirsutus* on grape and *Pseudococcus carymbatus* on citrus suppressed by*Cryptolaemusmontrouzieri*, Egg Parasitoids *Trichogramma*parasitize eggs of Lepidopteran mainly but also damages Coleopteran, Neuropteran and

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Dipteran insects, Tetrastichus attack eggs of Paddy Stem Borer, Pupal parasite – *Stomatoceros sulcatiscutellum*, Mid larval parasite – *Bracon hebtor*.

ii. **Predator:** A predator catches and devours smaller or more helpless creatures bykilling them in getting a single meal. It is a free-living organism, normallylarger than prey, and requires more than one prey. Example:Tiger beetles, Ladybird beetle feeds on harmful insects, Earwigs feed on dead decaying organicmatter, and also fly maggots.

Microbial Control

Microbial control refers to the exploitation of disease-causing organisms to reduce thepopulation of insect pests below the economically damaging levels.

i. **Bacteria:** The entry of the bacteria is by ingestion of thebacteria, which infect the midgutepithelial cells and enter the hemolymph to sporulate andcause septicemia and eventually kill the target pest. Example: Bacillus thuringiensis(B.t.) is important and is isolated from flour moth, *Ephestia kuhniella*known as a bacterial insecticide is now being used by farmers mostly on Lepidopterous larvae. *Agrobacterium radiobacter* – Crown Gall, *Bacillus thuringiensis* var. *israelensis* – Dipteran insects, *Bacillus thuringiensis* var *tenebrionis* – Coleopteran insects.

ii. **Fungi:** Mostly every species cause insect diseases using asexual spores called conidia. Usually, fungi act as important natural control agents that limit insect populations. Fungal conidia can directly germinateon the insect cuticle and produce specialized structures that allow the fungus to penetrate thecuticle and enter the insect's body. The disease induced by fungi in insects is commonly known as mycosis. Almost all of

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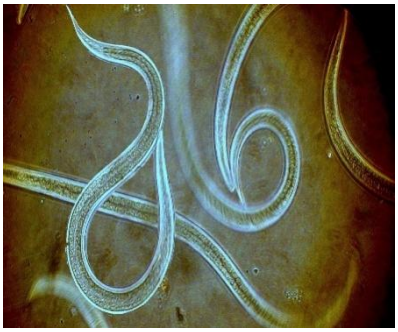
theentomopathogenic fungi infect the host through the cuticle. The process of pathogenesis begins withthe Adhesion of fungal infective conidium – Germination – Penetration – Multiplication – Death - Mycelial growth - Production of infective conidia. Examples*: Metarhizium anisopliae* (Green muscardine) on Orthoptera, *Aspergillus flavus* on Epilachna beetles; *Spicaria spp*. on castor whitefly, *Entomophthora grylli* on grasshoppers, *Beauveria bassiana* (White muscardine) on *Leptinotarsa decemlineata*, whiteflies, beetles & also on Caterpillars.*Verticillium lecanii on Aphids*, whiteflies & scales.*Nomuraea rileyion*foliage-feeding caterpillars, *Hirsutella thompsoniion* Citrus rust mite.

iii. **Virus:** NPV (Borrellina virus) about 700 isolates of nuclear polyhedral virus have beenisolated from the order Lepidoptera. Among these viruses Baculoviruses(Baculoviridae) aresuccessful in Pest Management. The virus infectsthe larvae hanging upside down from plant parts (Treetopdisease). The specific character of the virus-host relationship makes viruses an ideal candidate for use in the control of the targeted pest population. The cuticle becomes, rupturing easily when touched, discharges liquefied bodyfluids. NPV multiplies in insect trachea, body wall, fat bodies, and haemolymph at greater rates. The polyhedral is seen in nuclei. The polyhedral bodies enlarge in size destroying the host nuclei to get releasedinto the insect body cavity The NPV is observed to affect 200 species of insects like *Corcyracephalonica,Spodopteralitura, Pericalliaricini, Heliothis armigera, Amsacta albistriga*,etc., byingestion.The viruses that cause these outbreaks are very specific, eventually acting against only a single insect genus.

iv. **Entomopathogenic Nematode:**The EPNs *Steinernema spp* and *Heterorhabditis spp* from the families, Heterorhabditidaeand Steinernematidae have a mutualistic association with bacteria *Photorhabdusspp* and*Xenorhabdus spp*., respectively. They are obligatory requiring a living host for its survival. The stage that survivesoutside of the host is



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non–feeding viz., Infective Juvenile 3 (IJ_3). The Infective Juvenile carries cells oftheir bacterial symbiont in their intestinal tract and after locating a suitable host, the IJ entersinto its hemocoel through wounds, natural openings, or through the thin exocuticle. Once thenematode (IJ)enters into the hemocoel of the host it releases the bacteria into the blood where they rapidly multiply,propagate, and secret substances that rapidly kill the host and protect the cadaver fromcolonization by other micro-organisms.In addition to killing the host, the bacteria digest host cells and produces strong antibiotics to protect the host cadaver from saprophytes and scavengers to prevent decay.Overall, laboratory or field applications have been effective against over 400pest species, including numerous Beetles, flies, and mainlyCaterpillars.

v. **Protozoa**: They are single-celled eukaryotic organisms that exist in both water and soil.It infects and weakens young ones and adversely affects females by affecting reproducing capacity. The rate of fecundity decreases and eventually helps in pest control. Example: *Farinocystis triboli* on Flour beetle,*Malpighamoeba locustae* on grasshoppers.

Insecticides of plant origin.

The insecticides of plant origin extracted from natural products such as seeds, flowers, leaves, stems, and roots, aretermed botanical insecticides. Plant extracts also actas antifeedants.

i. **Neem (*Azadirachta indica*):** It possesses medicinal, insecticidal, insect repellent, antifeedant, growth regulatory, nematicidal, and antifungal properties. Neem Seed Kernel extract (NSKE) and Neem oil containseveral components such as Azadirachtin, Nimbin, Salannin, Nimbidin, Epinimbin that work as an insect repellent, Ovicidal, Antifeedant, and Growth regulator characters. Azadirachtin disrupts the moultingprocess by antagonizing the insect hormone ecdysone.

ii. **Nicotine:** It is found in the leaves of Nicotiana tabacum and N. rustica varies from 2% to 14% content of Nicotine. Nicotine sulphate is mainly used as a contact insecticide with fumigant action in the management of almost all sucking insectslike aphids,

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thrips, psyllids, leaf miners, and Jassid. Nicotine sulphate is less volatile and frequently stable. It is a highly toxic nerve-targeted poison when absorbed through the cuticle taken in through the tracheae or when ingested. It affects the ganglion blocking conduction of insects.

iii. **Rotenone:** It is obtained from the roots of the Derris plant which may contain 4 to 15 %rotenone depending on the variety. Rotenone occurs in Derris roots (4-9%), and Lonchocarpus (8-11 %). Rotenone consumed insects show a steady decline in oxygen consumption levels followed by paralysis and eventually death. It is very highly toxic to most insect species and fishes but almost harmless to warm-blooded animals.

iv. **Plumbagin:** It is a naturally occurring naphthoquinonechemical of plant origin from the roots of*Plumbago europea.* Plumbagin is well known for its antifertility, antimicrobial, molluscicidal,nematicidal actions, and other pharmacological properties.Moreover, its IGR properties are inhibition of chitin synthetase and ecdysteroid titers.

v. **Pyrethrum:** It is extracted from dried flower heads of *Chrysanthemum cinerariaefolium.* Pyrethrins are powerful contact insecticides but act as a poor stomach poison. The mode of action of the Pyrethroid is the rapid paralysis or **'knock down'** effect and substantial recovery that follows it. This recovery is due to rapid enzymatic detoxification present inthe insect body.

vi. **Solanum alkaloids:** Alkaloids such as (tomatine, solanine) extracted from species of Solanum reduce feeding and survival rates of Potato Leaf Hopper, *Empoasca devastans.* Besides the above, several othersubstances like non–essential amino acids, tannins, lignin, etc. act as antifeedants to many insects.