A Monthly e Magazine
ISSN:2583-2212
June, 2025 Vol.5(6), 7380-7387

Popular Article

Parasitic Management with Special Emphasis on Biological Control Methods

Dr. Nabanita Ganguly[1], Dr. S. D. Rathwa[2] and Dr. B. J. Thakre[3]
Assistant Professor, Riddhi Polytechnic in Animal Husbandry, Himmatnagar, Gujarat- 383001
Assistant Professor, Department of Veterinary Physiology, C.V.Sc, Kamdhenu University, Himmatnagar- 383001
Assistant Professor, Department of Veterinary Parasitology, C.V.Sc, Kamdhenu University, Junagadh- 362001
DOI:10.5281/ScienceWorld.15746702

Parasites pose a significant threat to agriculture and food security across the globe. Parasitic infections in livestock are responsible for approximately 13% of total animal mortality which significantly reduce productivity, degrade both the quality and quantity of animal products, and impair reproductive performance. Collectively, these impacts contribute to reduced farmer income and increased food insecurity, particularly in regions that heavily depend on livestock for nutrition and livelihoods.

To combat parasitic infections in livestock, three main control strategies are commonly employed: **mechanical**, **chemical**, and **biological** methods. The **mechanical method** involves the manual removal of parasites from the host or environment. However, this approach is often impractical and inefficient, particularly on a large scale, due to the labor-intensive nature of the process and the difficulty in reaching internal or microscopic parasites.

The **chemical method** has long been the most widely used approach for controlling livestock parasites. Currently, over 200 classes of chemical compounds are employed in treating parasitic infections. However, this method faces several growing limitations. A major concern is the **increasing resistance** of parasites to commonly used drugs, which reduces treatment effectiveness. Additionally, some of these chemicals pose **environmental hazards**, contaminate soil and water, and may **affect non-target organisms**, disrupting local ecosystems. Moreover, the **persistence of drug residues** in animal products such as milk, meat, and eggs poses potential health risks to humans, raising concerns about food safety and public health.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26 /06/2025

Biological control has proven to be a successful and sustainable method for managing pests and is an integral component of Integrated Pest Management (IPM) strategies. This approach involves the use of one group of living organisms to suppress or control the population of target pests. The biological control methods may involve either natural manipulation or laboratory-based procedures carried out by humans. The organism used to suppress the pest population is commonly referred to as a biological control agent (BCA).

Biological/ Bio- control Agents:

- **Pathogens:** Viruses, Bacteria, Fungi, Protozoa, Rickettsiae, Nematodes
- **Parasites:** Parasitoids
- **Predators:** Vertebrate, Invertebrate.

Pathogens:

Fungi

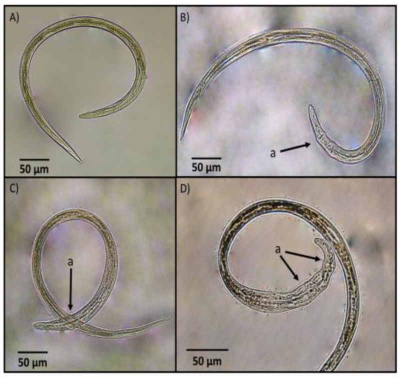
It can be classified into two: **Entomopathogenic fungi** and **Nematopathogenic fungi.** Fungi that infect and kill arthropod pests are referred to as "entomopathogenic fungi. It produces **spores** and the insect comes in contact with these spores either on the body of dead insects or surfaces or in the air as airborne particles. Spores germinate and penetrate the cuticle of the insect, usually at joints and produces symptoms like loss of appetite, muscular and nervous disorder, restlessness, attempt to climb high and upright position of legs at the time of death.

Examples: *Metarhizium anisopliae* and *Beauveria bassiana* are effective in the control of ***Culex pepiens*** and ***Rhiphicephalus sanguineus*** where the fungal spores can be applied in outdoor attracting odour traps, on indoor house surfaces and on cotton pieces hanging from ceilings, bed nets and curtains to control adult mosquitoes.

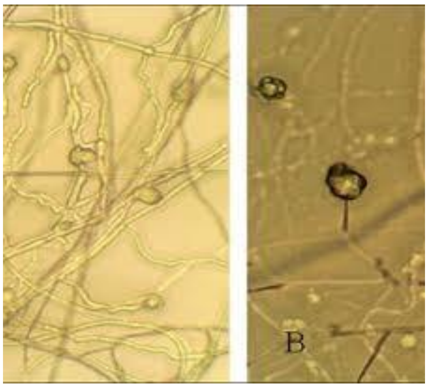
Fungi that infect and kill nematodes (worms) are referred to as nematopathogenic fungi. Over 150 species of fungi are known to invade nematodes which can be grouped into three: Nematode-trapping fungi, Endoparasitic fungi and root-knot nematodes. Most nematopathogenic fungi of veterinary importance fall in the group of **nematode trapping fungi.** They use **constricting (non-adhesive) or non-constricting (adhesive) rings**, sticky hyphae, sticky knobs, sticky branches to trap and kill nematodes by penetration and growth of hyphal elements within the host.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26 /06/2025

Examples: ***Arthrobotrys musiformis*** has been found to be effective against *Haemonchus contortus* infective larvae (Trichostronylidae) through its predatory activity and its fungal culture filtrates. ***Monacrosporium thaumasium*** has also shown promising results in reduction of *Cooperia punctata*, *Oesophagostomum* sp., *Trichostrongylus* sp. and *Bunostomum* sp. ***Duddingtonia flagrans*** is found to be an effective feed additives can reduce number of parasitic nematodes on pasture to the benefit of grazing animals when used at the recommended dose rate.



Arthrobotrys musiformis



Monacrosporium spp.

Duddingtonia flagrans

Bacteria:

The most important entomopathogenic bacteria belong to the genus ***Bacillus*** of which ***B. thuringiensis*** (Bt) is the most widely used agent in the biological control of insects. Within Bt, there are a number of serovars (including *israelensis, jega thesan, darmstadiensis, kyushensis, medellin, fukuokaensis, higo*), each containing proteins with parasicidal activity and ***Bt* ser. i*sraelensis*** (Bti) was the first to be found toxic against **dipteran larvae.**

An updated list of Bt genes encoding proteins with demonstrated anti-dipteran activity encompasses cry1, cry2, cry4, cry10, cry11, cry19, cry20, cry24, cry27, cry30, cry39, cry44, cry47, cry50, cry54, cry56. Several products of *Bacillus thuringiensis* are available in the market- **Dipel 2x** (*B. thuringiensis* var *kurstaki*), **VectoBac** (*B. thuringiensis* var. *israeliensis*) and **HD 703** (*B. thuringiensis* var *thuringiensis*)

B. sphaericus is effective in killing larvae of *Culex* spp., *Anopheles* spp and certain species of sand fly (vector for *Leishmania* spp.)

Paenibacillus glabratella, a recently discovered biocontrol agent showed positive results in controlling snails.

Streptomyces avermitilis, produces toxins collectively called “avermectins” which are highly effective against classes Insecta, Arachnida and Nematodes.

Viruses and virus-like particles:

Viruses belonging to the families **Entomopoxviridae, Reoviridae and Baculoviridae** have shown successful result in controlling pest population of which **Baculovirus** is the most widely exploited virus group for biocontrol. At present, there are approximately **16 biopesticides** based on baculoviruses available for use or are under development.

VLPs are self-assembled with viral protein and devoid of genetic material, making them non-infectious and safe to use.

Protozoa:

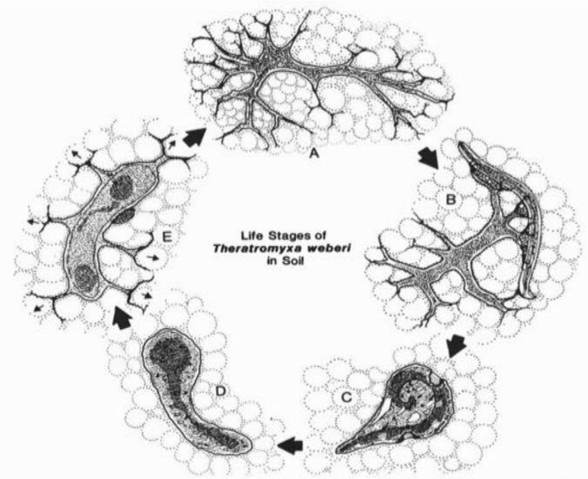
Some protozoa such as ***Haemogregarina, Babesia*** and ***Theileria*** are pathogenic to some arthropods like ticks. Predatory soil amoeba ***Theratromyxa weberi*** is capable of ingesting nematodes

Nematodes:

Nematodes belonging to the genera ***Steinernema*** and ***Heterorhabditis*** have been proven as effective BCAs to control insect pests like houseflies, fleas and other non-biting flies.

Others:

Rickettsia, a diverse group of bacteria, mostly transmitted by arthropods such as ticks, fleas and so on. During their stay, rickettsial organisms lead to alterations in tick behavior, interfere with their development and cause pathological changes in salivary glands and ovarian tissues leading to their death.



Sayre & Wergin 1989 Can J Microbiol

Earthworm consume a large volume of soil along with animal faeces containing nematodes present in the soil and faeces which acts as a dominating role in removal of cattle dung from pastures, reducing infective larvae of trichostrongyle nematodes on the pasture.

Predators:

feeds on other animal (i.e., prey) for their development, sustenance, and reproduction and generally larger than their prey.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26 /06/2025

Invertebrates:

Spiders: Spiders trap their prey by making typical web and sometimes they will use larva silk to make "capture nets" and are capable of consuming *Ascaris* ova in the soil. River prawns have been observed to prey on snails.

Mites : Some mites are nematode predators, for example, *Phytoseiid* spp. are capable of consuming *Ascaris* ova in the soil. They are also voracious predators of eggs and larvae of houseflies and other flies that develop in manure and faeces of livestock. ***Macrocheles muscae domesticae*** can eat up to 10 housefly eggs per day.

Flies: Predatory fly, ***Hydrotaea (Ophyra) aenescens***, presents a breakthrough in the indoor control of the housefly, *Musca domestica*. Small flies such as ***Mutilla glossinae*** are promising BCAs against the tsetse fly.

Insect herbivores: Insect herbivores like the cell-content feeder ***Liothrips ludwigi*** (Thysanoptera), the stem borers ***Merocnemus binotatus*** (Boheman) and ***Tyloderma* spp**. have shown promising results in the control of weeds. ***Scolothrips sexmaculatus*** prefers spider mite eggs but adult females will

Beetles: Dung beetles of the family Scarabaeidae are useful in the control of pasture livestock flies since they breed primarily in cow pats. ***Onthophagus ganelle*** and ***Euniticellus intermedius*** when introduced from Africa to Australia, showed reduction of ***Musca*** spp. upto 80–100% and the buffalo fly ***Haematobia exigua*** by 95%.

Vertebrates:

Amphibians and fishes: Water tortoise ***Pelomedusa subrufa*** has been reported to be able to remove ticks from black rhinos. Edible fishes such as ***Gambusia affinis, Guppy poecilia*** and carp fishes have tremendous potential as a larvivorous predator of mosquito and showed 98% reduction in the larval density of ***Anopheles*** spp**.** when introduced into water wells. ***Cyprinus carpio, Aplocheilus blocki, Tilapia spp, Catla catla, Labeo rohita*** and ***Cirrhinus mrigala*** have also shown promise in the control of mosquitoes.

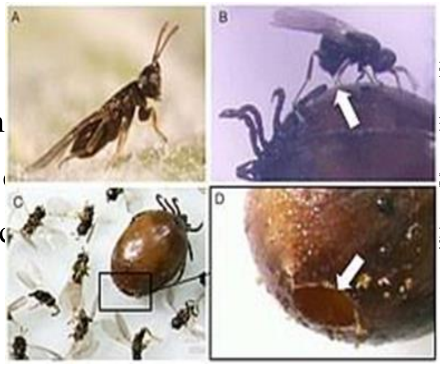
A study showed that ***Gambusia affinis*** preferred live larvae than commercial food and consumes about **100- 150** larvae per fish per day. They prefer **live larvae over dead larval** stuff and prefer to eat larva in the **presence of light.**

Reptilians: Australian gecko ***Gehydra dubia*** and the exotic Asian house gecko ***Hemidactylus frenatus*** have been observed to prey on mosquitoes and is therefore a promising tool for the biocontrol of malaria.

Avian and domestic fowls: Birds are natural predators of insects. Some bird species are known to pick off ticks from the host during flight or collect them from the ground and also eat the larvae of dung flies. Domestic fowls and birds are good predators of snails i.e., intermediate host of trematodes.

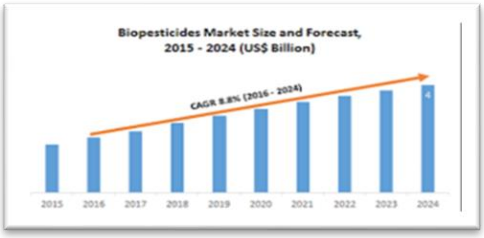
Parasites (parasitoids):

It is an organism that lives in close association with its host which s stenoxenous. The parasiotid wasp, ***Ixodiphagus hookeri*** (Hymen a many hard and soft tick species but shows promising result in t ***Dermacentor variabilis***. Braconid wasps have shown control over g greenfly.



Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 26 /06/2025



supports its development and/or reproduction. They donot occur in natural habitat but can sustain in laboratory condition.It is easier and less expensive to rear. Examples: Storage mites for predatory mites (Phytoseiidae, Laelapidae), Eggs of lepidopterans for insect predators, etc.

3) Artificial rearing systems: It uses artificial foods and preferably no plant materials. It may be tissues, haemolymph, protein, amino acids, cells etc.

IDEAL LOCATIONS FOR BIO-CONTROL UNITS:

- Care should be taken to set up biocontrol production units in areas which have **appropriate climatic conditions.**
- Location of biocontrol **production units** and **consumer market** (farming areas) should be close to each other
- Care should be taken so that the surrounding farming areas should not get any harmful effects from the biocontrol units.
- **Air pollution** can damage biocontrol agents, the production unit should be located away from industrial and urban areas

Present Status of BCA:

The global market of bio agents is expected to reach $4 billion by 2024 from $2 billion in 2016, growing an increase with 8.8% from 2016 to 2024. The USA accounts for 40% of the global bio pesticide followed by Europe (20%) and Oceania (20%).

- In India, biopesticides industry shows a growth rate of 20.2 % since 2010 -2020.
- At present there are total **361 biocontrol laboratories/un**its in India of which
- ***141** are under the private sector laboratories,
- ***98** nos. are under state biocontrol laboratories,
- ***49** nos. are under ICAR/SAUs/DBT laboratories,
- ***38** nos. are under private sector getting grant from Government of India.,
- ***35** nos. under Central Integrated Pest Management Centers (CIPMC).

In **2022,** India has made its first announcement on 7th National Conference on Biological Control from **5-7** August in Bengaluru.

APPROACHES TO BIOCONTROL:

1) **Importation:** It involves introduction, screening and release of natural enemies to permanently establish effective natural enemies in a new area which will target the native pest to control.
2) **Augmentation:** It typically involves the purchase and release of natural enemies that are already present in an area but not in quantity, enough to adequately keep in check the pest population in a particular location.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 26 /06/2025

3) **Conservation:** This includes avoidance of measures that destroy natural enemies and the use of measures that increase their longevity and reproduction in an environment.

CHALLENGES:

- If a BCA attack any native non-target species, its persistence and ability to spread to areas far from the site of release become a serious liability.
- Non-native BCA can carry non-native parasites and commensal species.
- BCA are easily influenced by environmental factors such as temperature, humidity and oxygen extremes, which determine the success of the biological control strategy.
- Distribution of BCAs product, especially those containing living organisms are not easy.
- Most industries producing BCA products are often situated a considerable distance away from where the BCA is to be used
- There is no information available on the economic viability of those strategies; biological products must have competitive costs relative to chemicals to allow their use by farmers.
- Lukewarm attitude among who find it difficult to forego their fast-acting chemical pesticides over the sluggish BCA.

CONCLUSION

- Biological control approaches hold promise as the most suitable alternative to the chemical pesticides and are now a core component of IPM (Integrated Parasite Management).
- A good number of promising BCAs including predators, parasites (parasitoids) and patho- gens (fungi, bacteria, viruses and virus-like particles, protozoa and nematodes) have been identified and proven to be efficacious against many parasites of medical, veterinary and agri- cultural importance
- With the recent advances in biotechnology and the application of most recent technologies such as nanotechnology and microencapsulation, there are many opportunities for the continued use and expanded role of natural enemies in biological control.
- Newer BCAs are being identified and older ones are being genetically engineered to make them more efficacious in their antagonism of parasites.
- In the future, biological control will develop to overcome many of the challenges, and BCAs will become the mainstay for the control of parasites

@@@@@@