**Minia University**

**Faculty of Science**

**Department of Zoology and Microbiology**

**GRADUTION PROJECT**

Research on

# INSECT CONTROL

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# Introduction

Insects are the most numerous of living organisms and the nearly one million described species constitute approximately 72% of all animal species. Of these about 1% are considered significant pests. This article summarizes the chemistry, properties, uses, and advantages and disadvantages of most of the chemicals used for insect control. These include many products of largely historical interest as well as some not registered for use in the United States but used elsewhere in the world. Approximately 70% of all insecticide use is in agriculture and applications are generally made directly to raw agricultural commodities to protect plants and animals from insect attacks. With the exception of microbial insecticides, nearly all of the uses of insecticides result in residues of the various chemicals and their degradation products. Consequently, Natural control refers to the maintenance of insect populations within certain bounds by environmental conditions, or factors. Both non-biological and biological factors contribute to the natural control of insects.

# Types of insect control

Most specific insect control methods can be classified into the following major categories: cultural control, host resistance, physical control, mechanical control, biological control, and chemical control

# Types of Pest Control Methods

Pest control services use a variety of approaches to deal with infestations, but these can be sorted into three main types of pest management, which we will explain in detail below.

## 1- Physical Pest Control

Physical pest control involves the trapping and killing or removal of pests to remove them from an environment. It may also involve putting up physical barriers and 'pest proofing' premises to stop pests from returning or entering in the first place.

Common examples of physical pest control include removing or destroying nests, blocking holes, windows or doorways, temperature control methods to kill pests, or setting traps to catch pests and then remove them from the area. In farming, methods such as field burning and trap cropping are also common physical control methods.

### ➢ Advantages

- The biggest advantage of this kind of pest control method is that it doesn't involve any kind of dangerous chemicals that can have an impact on the environment or an individual that accidentally comes into contact with a substance used for pest control
- These methods are also usually environmentally friendly

- Physical pest management is also a method that pests cannot develop any kind of resistance to, which means its an approach that will always be as effective as possible

## ➢ Disadvantages

- A key disadvantage of physical pest control that involves trapping is that many people believe that it is inhumane to trap animals and remove them from their natural habitat, even if this is done with health and safety in mind
- Physical pest control that involves killing pests is also considered to be inhumane, particularly when they are rodents or larger creatures
- On a practical level, if you have a large infestation then physically removing all of the pests will be a very tricky and time-consuming task, so its effectiveness is not as high as other methods
- This method isn't also a very reliable approach to stopping pests from returning to their original infestation site

## 2-Chemical Pest Control

Chemical pest control methods are the most widely used approach to pest control. They are also commonly used to control weed infestations and diseases in crops.

Pesticides are the name used to describe chemical pest control substances, which usually poison and kill the pest that consumes or is exposed to them. These may be used in combination with physical traps or just be left out in places where pests are known to be. Only qualified pest control technicians can and should have access to chemical pesticides, as these substances are toxic and can be incredibly harmful if ingested by a human.

Another chemical pest control method is ultra-low volume (ULV) fogging, which is used to combat insect infestations and spreads small amounts of insecticide. On the opposite end of the scale, fumigation is an extreme chemical pest control method that involves sealing a building and filling it with pesticide to annihilate any pest on the premises.

### ➢ Advantages

- The main advantage of chemical pest control is that it is very effective and yields relatively fast results when it comes to removing pests
- Pesticides are also quite a cheap method of pest management, with very weak substances available to purchase for people without pest control qualifications
- Chemical pest control methods are also pretty quick and simple to use

## ➢ Disadvantages

- Almost all chemical pesticides are highly toxic and can cause serious issues if ingested by things that aren't pests, such as household pets and even people
- Frequent and heavy use of chemical pesticides can contaminate groundwater or leave residue on plants which can lead to health issues
- It is possible for pests to develop resistance to chemical pesticides, which can cause major issues when it comes to trying to control this new resistant species

# Environmental Impact

The harmful effects of traditional pest control methods Pesticides can also contaminate soil, water, and air, leading to long-term environmental damage. Moreover, exposure to these chemicals can pose health risks to humans, including respiratory problems, skin irritation, and neurological disorders.

## The Most Environmentally Friendly Pest Control Methods

- Pest Proofing.
- Bait Stations.
- Heat Treatments.
- Organic Garden Treatments And Deterrents. Garden-Friendly Bugs.
- Baking Soda.

# 3- Biological Pest Control

The last of the 3 methods of pest control is biological methods which is one of the oldest forms of pest management. This consists of using other natural organisms to reduce or remove a species of pest, which usually involves introducing their natural predator to the same environment to manage the pest population. It's not commonly used as a method of dealing with pests in a health and safety context, but may be used to control larger populations of pests which could pose a risk to those who live in the same area.

Natural predators are one form of biological pest control method, but another that tends to be used on plants is the introduction of microorganisms that protect their host species by deterring any pests.

**Types of Biological Control Agents**

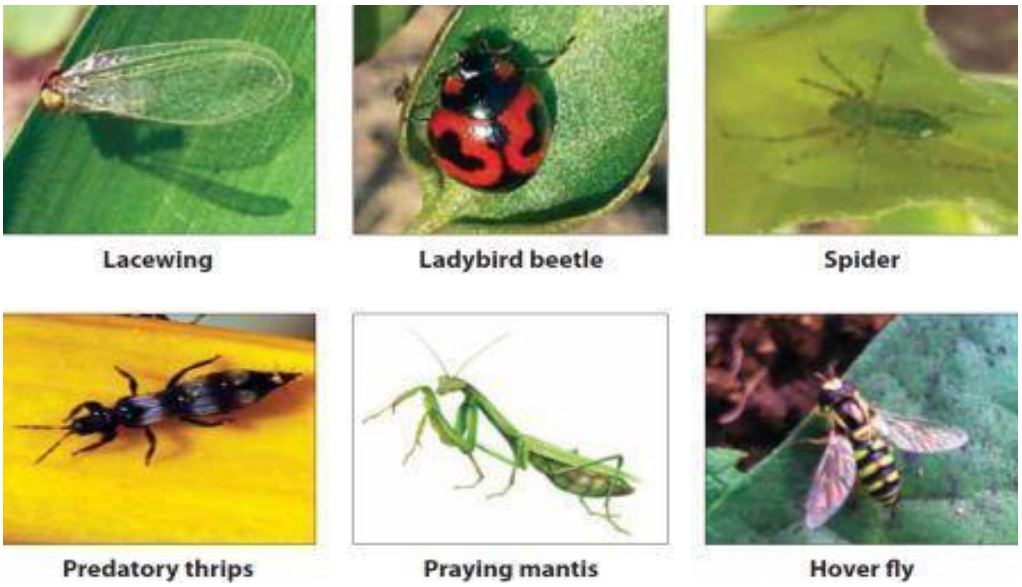
Natural enemies of insects and mites generally fall into four different types, or guilds, based on how they utilize their prey or hosts: predators, parasites, parasitoids, and pathogens. Predators are organisms that feed on the target pests and include insects such as lady beetles, green lacewings, rove beetles, hover flies, and predatory mites . Parasites and parasitoids are interchangeable terms for some practitioners, but there are significant differences between the two types. Typically, parasites are microorganisms that live, feed, and lay eggs on or in a host without killing it. Parasitoids do the same as parasites but eventually kill the host. Parasitoids are typically parasitic insects such as tachinid flies or parasitic wasps . Pathogens include microorganisms, such as fungi, bacteria, nematodes, and viruses that cause diseases in pests. Pathogens that are used against insects and mites are referred to as "entomopathogenic."

Natural enemies of plant pathogens are generally microorganisms similar to their targets (i.e., fungi, viruses, and bacteria). These microorganisms interact with plant pathogens in four primary ways: competition, hyperparasitism, induced resistance, and production of antimicrobial compounds.5 Competition is relatively straightforward. A large number of beneficial microorganisms is applied to the environment, which takes up all the available living spaces or resources and denies occupancy by plant pathogens. Bacillus subtilis is a common example, where products containing this bacterium are applied to soil or soilless growing medium to out-compete root rot causing pathogens . Hyperparasitism occurs when a beneficial microorganism parasitizes and eventually kills a plant pathogen. Some beneficial microorganisms can induce or cause plants to produce defensive chemical compounds to fend of pathogens (i.e., resistance). Hyperparasitism and induced resistance are very specific interactions among plants, beneficial microorganisms and pathogens, but are not widely utilized commercially. Production of antimicrobial metabolites that stop growth or kill the pathogens is the most common way biological control is used for disease management. The beneficial microorganisms, often bacteria, are mass-reared in

fermentation vessels to produce specific antimicrobial compounds, which are later extracted and used as antimicrobial pesticides. The beneficial microorganisms can also be applied to the plants. When the beneficial microorganisms die, their cells release the antimicrobial compounds onto the leaf surface, thus killing the pathogens nearby or protecting the leaf from infection. Once again, some B. subtilis products are examples of using antimicrobial compounds. These products are sometimes mixed with copper-based fungicides to enhance the effect.

## ➢ Advantages

- Biological pest control is generally the most environmentally-friendly method you can use, as it doesn't involve any kind of synthetic substance or the killing or removal of a species by humans




- It's also a long-term solution which means that pest control is usually only needed once

- Introducing a natural predator as a way of controlling pests also doesn't require much cost or effort after the initial introduction, so it's a method that essentially looks after itself

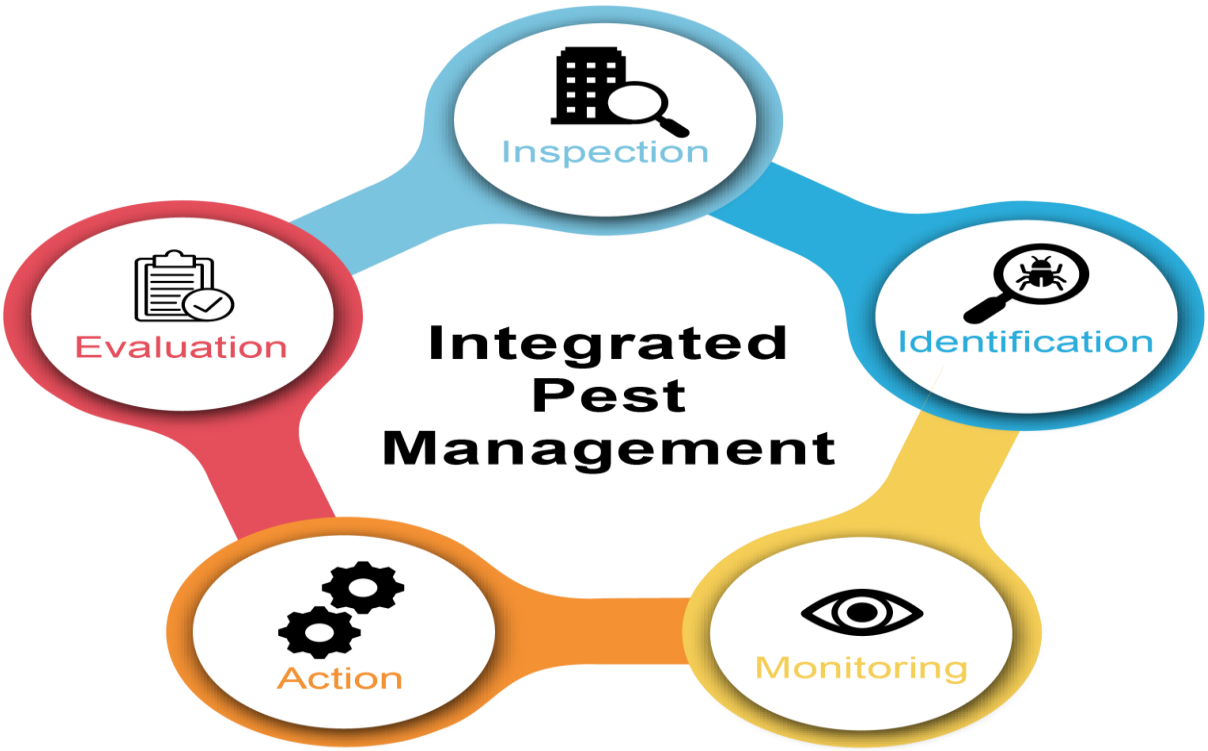
## ➢ Disadvantages

- Biological pest control is not a particularly reliable method because you cannot dictate how a predatory species is going to act when introduced into a new area
- It's not a very fast process so isn't suitable for instances where a pest infestation needs to be quickly dealt with, nor does it totally wipe out a pest population
- In some cases, introducing a new species into an environment can disrupt the natural balance and established food chain and lead to another infestation of the predatory creature, which will then need to be reduced or removed

# Emerging Technologies

Emerging Technologies have been successful in capturing and repelling insects in laboratory studies. They are also well known for their effectiveness in killing insects through arc discharges of instantaneous and transient electric current. Their mode of action will largely depend on the configuration of the conductors generating the Felds as well as the applied voltage, which we illustrate below. For the cases of capturing and killing insects, the interaction between the insects and the Felds is purely electrostatic; these Emerging technologies do not directly engage either the neurobiology, behavior, or physiology of the insects. In other words, their mechanism of action only involves direct physical interactions, not strictly biological aspects of the insects. However, the repellent phenomena described below suggest that some Emerging Technologies may be able to leverage an ability of insects to detect Emerging Technologies.

# Integrated Pest Managements (IPM)




IPM is a system that in the context of the associated environment and the population dynamics of the pest species utilizes all suitable techniques and methods in as compatible manner as possible and maintains the pest populations at levels below those causing economic injury." According to the consultative Group for International Agricultural Research (CGIAR) "Sustainable agriculture is the successful management of resources to satisfy the changing human needs, while maintaining or enriching the quality of environment and conserving the natural resources."

Integrated Pest Management (IPM) is potentially an effective tool of insect Pest's management. IPM is generally inexpensive, durable, non-polluting and locally

improvable, which make it sustainable component of an integrated crop protection

# Resistance and Resilience

Resistant varieties/Host Plant Resistance (HPR) The fundamental objective of HPR in crop plants is to produce an acceptable level of sustainable resistance; such resistance should the same time compatible with optimum crop yield and quality. The ultimate objective of HPR programmed is to develop insect resistant varieties for on farm production to minimize crop losses from Herbivore attack.

# Types of Resistance

- ## Ecological resistance/ Pseudo resistance

Host may pass through the most susceptible stage quickly or at a time insects are less or evade injury by early maturing. This pertains to the whole population of host plant. ii. Induced resistance: Increase in resistance temporarily as a result of some changed conditions of plants or environment such as change in the amount of water or nutrient status of soil. iii. Escape: Absence of infestation or injury to host plant due to transitory process like incomplete infestation. This pertains to one or few individuals of a population.

- ## Genetic resistance.

Genetic resistance may be grouped under various categories:

**a- Monogenic resistance:** When resistance is controlled by a single gene, it is called monogenic resistance. Advances Strategy in Plant Protection | 65

**b- Oligogenic Resistance:** When resistance is governed by a few genes, it is called oligogenic resistance.

**c- Polygenic Resistance:** when resist is governed by many genes, it is referred to as polygenic resistance. The term ‘horizontal resistance; has also been used to denote the resistance governed by polygenes.

d- **Major gene resistance:** when resistance is controlled by one (monogenic) or a few (oligogenic) major genes isCalled major gene resistance. This is also called “vertical resistance” (specifi c Resistance). Major gene has a strong effect and can be identifi ed easily.

# Public Health Implications

The relationship between insects and public health is not new, as the role of insects

as pests has been recognized since ancient times. Recently, however, it has become clear that both, negative and positive impacts of insects toward human and animal health are growing and will continue to grow in the next decades. Negative impacts of insects as pests and vectors of diseases are increasing due to climate change and globalization with geographical expansion of insect habitats and a growing possibility to host pathogens. Positive impacts are getting more consideration. The important role of insects as pollinators is widely acknowledge due to the threat of soil deterioration and biodiversity losses. Their Insects 2023, 14, 240 11 of 15 use as food or feed is attracting great interest due to the need for sustainable protein sources. These positive impacts are changing attitudes toward them. These quantitative and qualitative changes of insects-human relationship need to be taken into account within the public health sector. Public health is the science of protecting

and improving the health of people and their communities. Protecting people from the negative effects of insects as pests and as vectors of disease is an aspect of public health. Encouraging the use of new and sustainable sources of

food, protecting health and welfare of farmed insects is another aspect of public health. New responsibilities call for the update of training and education for professionals involved in these fields, namely biologists, veterinarians, doctors and others. Public health authorities should contribute and favor the increase of innovation in mechanization, automation, processing and logistics to reduce production costs, as well as to increase the level of food and feed safety of insect mass-rearing production. They should also (a) develop feeding tables for insects and the nutritional value of substrates, conduct extensive life cycle assessments among a vast array of insect species to enable comparisons of insects with conventional feed and food sources, (b) maintain resilient genetic diversity to avoid colony collapse in insect farming systems, (c) develop voluntary best rearing practices, codes and regulatory frameworks governing insects as food and feed, as well as human health and animal welfare at the national and international levels (e.g., the Codex Alimentarius, Efsa, European Commission, FAO), and (d) improve risk assessment methodologies for risks related to mass-rearing and wild gathering in order to safeguard against the introduction of alien and invasive insect species to wild populations.

# Conclusion

Many insects cause a lot of damage to agricultural crops and livestock or pose a threat to human health. The main tool used to control pests and insect vectors is insecticides, but chemical-free insect control methods are urgently needed due to the growing problem of insecticide resistance. Novel methods based on the Emerging Technologies could expand the available options for insect control and help to reduce problematic insecticides. The Emerging Technologies seems to be promising in repelling, capturing, or electrocuting insects. However, important research questions need to be answered to better understand insect–EF interactions, which will allow us to optimize the technology for different insect species and environments, and to ensure sustainable and safe long-term usage.

Threats and opportunities will arise from insects in the near future. Public health professionals should continue to address the threats, increasing their knowledge of efficient surveillance and control strategies. In addition, they should encourage the efforts of businesses in grasping the opportunity to address food security issues, develop insect safety assurance systems, and working along the whole supply chain, merging experiences from other sectors with respect to the use, control and care of insects.

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