

### **3-Biological controls**

Due to problems associated with chemical control, emphasis nowadays has been placed on alternatives such as biopesticides. This is the use of living organisms to minimize the undesirable effects of pests by reducing the pest population. Living organisms that are used as biological control include parasitoids, predators, and pathogens. The pathogen includes microorganisms such as fungi, nematodes, protozoa, bacteria, and viruses.

#### **A-Parasitic wasps (Order: Hymenoptera)**

Some species of wasps are parasitoids of the eggs and larvae of beetles and moths in stored products. Parasitoid wasps do not attack the stored product in which they are found. By attacking pest species, they perform a useful service and studies have shown that they can have a significant impact on the population of many storage pests. However, for many stored products the presence of any insects is commercially unacceptable. Recently there has been more interest in using parasitic wasps to control pests under conditions of farm storage. Release of wasps has also been undertaken to control remaining populations of insects in factories and empty storage structures.

Parasitoid wasps are small wasps most are winged and have complete metamorphosis. The junction between the thorax and abdomen is constricted to form a waist.

Major families associated with stored products are

### 1-Family: Ichneumonidae

*Venturia canescens* is internal parasitoids that attack the larva of *plodia interpunctella* , *Ephestia* spp, *Corcyra cephalonica*



### 2-Family: Braconidae

*Habrobracon* spp is internal parasitoids that attack the larva of *plodia interpunctella* , *Ephestia* spp, *Corcyra cephalonica*



### 3-Family: Bethylidae

*Cephalonomia* spp is external parasitoids that attack the larva of *lasioderma sericorne*, *stegobium paniceum*, *Sitophilus* spp, *Oryzaephilus surinamensis*.



#### **.4-Family: Trichogrammatidae**

*Trichogramma* spp is internal parasitoids that attack the egg of wide ranges of moth species.



#### **B-Predatory bugs (order: Hemiptera)**

Most are winged and have incomplete metamorphosis which eggs hatch into nymphs that are similar in appearance to adults except that they are smaller.

##### **Family: Anthocoridae**

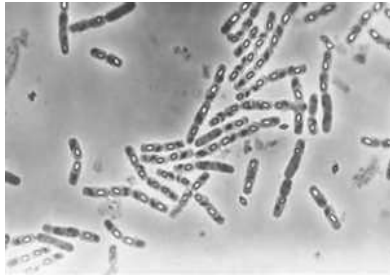
*Lyctocoris campestris*

Both adults and nymphs feed, especially the nymph attacks the immature stages of moths and beetles. Predatory bugs are predators of a wide range of insect and mite pests and their presence in large numbers in storage facilities indicates an established pest population. Predatory bugs do not damage stored commodities, but their presence may be an issue of contamination.

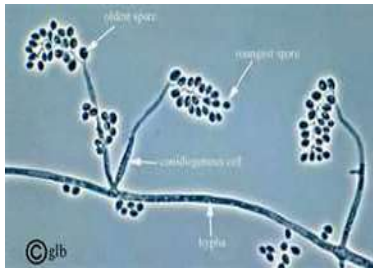


## C-pathogenic groups

Regarding the pathogenic groups, the bacteria *Bacillus thuringiensis* is considered the most successful pathogen. Also in fungus groups (*Beauveria bassiana*) have been used extensively as biopesticides usually will be used on insect pests in the field.



*Bacillus thuringiensis*



*Beauveria bassiana*



## 4--Plant extracts for insect pest control.

Plant extracts known as biocide or green pesticides are considered a rich source of bioactive chemicals, suitable for use in integrated pest management

Plant extracts have great potential to be used against insect pests since the time of ancient Rome. Different species of plant extracts have been used as biocides either to manage or minimize the field loss due to pests.

Various plant extracts (e.g. *Eucalyptus*, *Nicotiana tabacum*, *Zingiber officinale*) and the toxicity of extracts to insects varied on the type of the plant, extract type, exposure time, and doses. For instance, different parts of the plants (leaves, peel, seeds, fruits) can be used and washed carefully with water, air dried in the shade, and ground into fine powder by using an electric grinder that can be used to control

the insect pest either as a powder or liquid assay (in water or ethanol) and then preparing a serial dilution.

Much effort has, therefore, been focused on plant-derived materials for potentially useful products as commercial insect-control agents. Essential oils are secondary metabolism products in plants with a complex mixture of a large number of ingredients. These oils have strong aromatic components that give a plant its distinctive odor, flavor, or scent. Besides, secondary compounds from plants include alkaloids, terpenoids, phenolics, flavonoids, Iimonoides, and other chemicals that might affect insects variously. The oil possesses a wide spectrum of biological activity including antimicrobial, fungicidal, insecticidal, herbicidal, and nematicidal.

### **Advantages of Plant extracts:**

- 1-Consider as a rich source of bioactive chemicals,
- 2-Suitable for use in integrated pest management and could lead to the development of new classes of safer insect-control agents.
- 3- They may disrupt major metabolic and cause fast death.
- 4-Act as attractant deterrents and anti-feeding or modify ovipositor.
- 5- Can be a substitute source of chemical pesticides, safe, eco-friendly, inexpensive, and easy to use without the appearance of pest resistance.

## **5-Effects of microwaves to control insect pests**

Microwaves are defined as a part of electromagnetic waves which have a frequency range between 300 MHz to 300GHz corresponding to wavelength from 1mm to 1m, Microwave frequencies of 915 MHz and 2.45 GHz can be utilized for industrial, scientific, and medical applications, and described process is a high temperature- short time. Microwave heating is based on the transformation of alternating electromagnetic field energy into thermal energy by affecting polar molecules of a material.

The use of higher temperatures as a non-chemical alternative to fumigation has been a feasible treatment for stored-product insects in various food facilities for many years. An attempt made in the early 1900s encouraged some food processing companies to this technique for several years, now there is renewed interest in exploring heat treatments as a substitute for chemicals. On the other hand, the main concern with microwave energy is that it might affect the functional properties of stored products via thermal impact. Though, the heating energy positively influenced product characteristics in many studies,

### **Advantages of microwaves:**

- 1- Control of all developmental stages of storage pests,
- 2- Affects the reproduction behavior of the survivors,
- 3- Having no chemical residues on the food product,
- 4- Having minimal impact on the environment
- 5- Short microwave exposure time within a few seconds.