Advanced of Stored Products Insects- 2024- Lec. 2- Master grad-

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Insects:

Insects-infested stored products are grouped into order (beetles, moths) . The larvae of these moths and beetles are all pale-white or cream in color and may be difficult to distinguish, but the adults are easier to identify. The adult beetles will mostly be found with their grubs, feeding on the stored products, but the adult moths do not feed and will only lay eggs. Large infestations can create favorable conditions for the growth of secondary fungal and bacterial pathogens. However, under optimum conditions, many of the species can complete their life cycles in less than 30 to 35 days and lay many eggs. Most stored product insects are either beetles or moths, both have complete metamorphosis, they have four distinct developmental stages: egg, larva, pupa, and adult. The. Major damage was mainly caused by insects, which account for an average of 10-20 percent of storage. In general, stored products of agricultural and animal origin are attacked by more than 600 species of coleopterans, 70 species of lepidopterans. They are causing both quantitative and qualitative losses

Stored product insects' characteristics and success

1- Diapause rarely occurs and thus can reproduce all year around and infest stored grains.

2- Mostly with short development periods of life cycle so they have several generations per year.

3- High fecundity, rapid increase in their fecundity

4- Negative photo taxis are common characteristics, they avoid bright light and hide in grain inside stores.

5- Insects generally have a small size enables to hide and move within and between food particles.

6-The hard exoskeleton that is made of chitin and called a cuticle has several benefits.

Main sources for insect infestation:

Infestation of storage products before harvest is common so grains may enter a storage having a low level of concealed infestation. Depending on climatic conditions, these insects can multiply rapidly and cause severe damage especially if they are small in size and can hide easily.

the main sources of insect infestation are:

1- Field infestation/ Some stored product insects can fly and move from one place to another searching for food. Thus infestation might occur to seeds while it's growing on the plant or before their harvest then would cause major damage in stores by increasing their numbers. Field infestation usually happens in tropical and semi-tropical areas because the cold condition usually decreases insects' activity. Examples of pests that start seed infection in the fields are *Sitophilus oryzae* and *bruchid* beetles. Bruchidae family has high field infestation as the female lays

eggs inside the fruits and after hatching larvae enter seeds. After harvesting infected seeds would transfer to stores and the insect larvae continue to grow and develop into pupae then adults.

2- Farm storage/ Farmers might keep the harvest temporarily in unsanitary places before either storing it in warehouses or distributing it to consumers. The percentages of seed infestation would increase as long as it remained in the contaminated area for a long time and are considered a major source of infestation when transferred to warehouses.

3- Storage of animal feeds/if the animal feed store was close to the food warehouse, the latter would be highly infected by insects.

4- Combines/After harvesting, grains might remain inside combiners that would be a source of further insect infection when used in the following season. Also inside transportation means like trains and ships might hide. Thus, the infected seeds with insects would be transferred to the stores and warehouses.

5- Sacs and containers/Previously used sacs and containers for seeds transporting would provide shelters for stored product insects. Hence, different life stages of insects e.g. eggs, larvae, pupae, and even adults might hide in it. Insects would survive inside sacs because they could resist unsuitable conditions such as food shortages and high temperatures by going through a diapause period.

6- Warehouses, silos, and flour mills/ Consider main sources for insect infestation especially when neglected and not equipped with required modern technology ventilation. Insects would hide either inside the holes and cracks or inside the mechanical conveyor that is used for transportation.

Insect pests of stored grains can be divided into six groups according to the type of infestation:

1-Primary insect pests or Internal Feeders –

These are some of the most economically important pests of food globally, being able to destroy large amounts of grain in storage. Attack whole grains, larvae feed and develop within the kernel like wheat, barley, rice &corn. Primary pests tend to have a more restricted host.

- Granary weevil, *Sitophilus granarius*
- Rice weevil, *Sitophilus oryzae*
- Lesser grain borer, *Rhyzopertha dominica*
- Cadelle, *Tenebroides mauritanicus*
- Angoumois grain moth, *Sitotroga cerealella*
- Khapra beetle, *Trogoderma granarium*

2-Secondary insect pests or External Feeders –

This group of stored product insects feed on broken grains, flour, cereals and a wide range of other dried plant and processed products. They include some of the most important pests in grocery stores and homes. Feed on grain dust and broken kernels – Cannot damage whole grain – Follow internal 5 feeders. Larvae are free-living during development. Secondary pests attack a very wide range of materials of both animal and plant origin.

- Confused flour beetle, *Tribolium confusum*
- Yellow mealworm, *Tenebrio molitor*
- Flat grain beetle, *Cryptolestes pusillus*
- Siamese grain beetle, *Lophocateres pusillus*
- Broadnosed grain weevil, *Caulophilus oryzae*
- Mediterranean flour moth, *Ephestia kuehniella*

- Indian meal moth, *Plodia interpunctella*
- Australian spider beetle, *Ptinus ocellus*
- Whitemarked spider beetle, *Ptinus fur*
- Dermestid beetles
  (*Dermestes*, *Anthrenus*, *Trogoderma*, *Attagenus*) generally carrion feeders, they are common in warehouses, granaries, four mills and food packaging plants

3-Tertiary insect pests (tertiary feeders)/ rarely cause direct damage to grains & stored materials by contamination. Cockroaches Common earwigs.

4-Fungal feeders. Are often present in poorly stored grain or in grain heavily infested with other insects.

5-Predators. Many storage pests will prey on other insects present, including members of their species. Obligate predators only feed on other insects.

6-Parasitoids. Several parasitoid wasps attack beetles and moths. Larvae of these wasps develop in or on their host, eventually killing it. These are potential 'beneficial' insects as they can control pest populations.

7-Scavengers. Some scavenger species feed on bodies of insects and other dried material of animal origin. Many are important pests of stored products of animal origin such as wool, skins, and dried fish.

Insect pests of stored products can be divided into six groups according to the type of Products:

1-General feeders

These species have been found in a wide range of foods in addition to those indicated by their names, including cereals, flour, nuts, seeds, chocolate, spices, beans, tobacco, dried fruit.

- Sawtoothed grain beetIe, *Oryzaephilus surinamensis*
- Merchant grain beetle, *Oryzaephilus mercator*
- Cigarette Beetle, *Lasioderma serricorne*
- Biscuit beetle, drugstore beetle, *Stegobium paniceum*
- Tobacco moth, *Ephestia elutella*
- Almond moth, *Cadra cautella*

2-Meat and cheese pests

Dermestes beetles are generally carrion feeders and are pests of preserved and processed meats and cheese. They can breed in carpets, hides, bird and insect nests and dead rodents — they are even used to **clean animal skeletons in museums**. Larvae can bore into wood or other hard materials to pupate.

- Redlegged ham beetle, *Necrobia rufipes*
- Larder beetle, *Dermestes lardarius*
- Black larder beetle, *Dermestes ater*
- Hide beetle, *Dermestes maculatus*

3-Dried fruit pests

These stored product insects are generally feeders of multiple food types. They are more likely to infest dried fruit if it has been stored for long periods or if it is fermenting or decaying through poor storage. Some beetles feed on mould growing on rotting foods.

- Indian meal moth, *Plodia interpunctella*
- Mediterranean flour moth, *Anagasta kuehniella*
- Almond moth, *Cadra cautella*
- Driedfruit moth, *Vitula edmandsae serratilineella*
- Stored nut moth, *Aphomia gularis*
- Sawtoothed grain beetle, *Oryzaephilus surinamensis*
- Merchant grain beetle, *Oryzaephilus mercator*
- Dried fruit beetle, *Carpophilus hemipterus*
- Tobacco beetle, *Lasioderma serricorne*
- Flour beetles, *Tribolium* species
- Rusty grain beetle, *Cryptolestes ferrugineus*

4-Nut pests

- Confused flour beetle, *Tribolium confusum*
- Rust red flour beetle, *Tribolium castaneum*
- Saw-toothed grain beetle, *Oryzaephilus surinamensis*
- Merchant grain beetle, *Oryzaephilus mercator*
- Indian meal moth, *Plodia interpunctella*

5-Legume pestsBruchid beetles, such as the **Bean Weevil, *Acanthoscelides obtectus***. This was originally a tropical species, from Central America, but has spread around the world in food shipments and is a significant pest in many countries.

Types of larvae (Coleopteran order)

Larvae of beetles found in stored products have one of five distinct body forms, which are described and illustrated below.

1-Apodous – legless, immobile, and lives internally within the foodstuff

2-Scarabaeiform – effectively immobile when mature, legs partly or fully developed. Lives internally within foodstuff for all or all but the initial stage of life.

3-Campodeiform – elongate flattened body with well-developed legs, usually pale, and head capsule and/or last abdominal segment may be pigmented. Active, lives freely within the commodity.

4-Elateriform – the body is long and cylindrical, the cuticle leathery, legs relatively short. Active, live freely within commodity

5-Eruciform – oval or elongate and hairy. Active, live freely within commodity


Apodous


Scarabaeiform


Campodeiform


Elateriform


Eruciform

Signs of stored product insects;

It is important to conduct detailed inspections of stored products and storage areas to identify an infestation as early as possible. Examine deliveries on arrival and make regular checks on food that has been in storage for a while — make sure suppliers and shipping or transport agents also have a regime of inspection and monitoring.

The common signs of a stored product insect infestation are:

1-A product shows signs of damage

2-Live or dead insects in the food storage areas, beams, windowsills, food processing machinery, packaging and food products

3-Food spillages containing live insects, larvae, pupae or silken webbing

4-Holes in packaging

5-Beams and window sills: where food is stored these have larvae, pupae or silken webbing