Insect Identification and Biology
Importance of accurate insect identification

- Knowledge of insect biology and morphology
  - necessary to be able to identify insects properly
- Proper/accurate insect identification
  - key to making an informed control decision
- Incorrect identification
  - may lead to expenditures on control where none is necessary
Pest Insect Orders of Concern in Stored Grain

- **Orders**
  - Psocoptera: Psocids, booklice
  - Coleoptera: Beetles
  - Lepidoptera: Moths, caterpillars

- **Other**
  - Acari: Mites

- **Beneficial Orders (potentially; include parasitoids)**
  - Diptera: Flies
  - Hymenoptera: Wasps
Insect Biology – Life Cycles

- **Incomplete Metamorphosis**
  - Egg, nymph (juvenile), adult

- **Complete Metamorphosis**
  - Egg, larva (juvenile), pupa, adult

Hemipteran lifecycle

Coleopteran lifecycle

Psocopteran life cycle

Lepidopteran lifecycle
Insect Morphology

hd = head
th = thorax
ab = abdomen
ant = antenna
e = compound eye
t = terga (tergum)
stn = sterna (sternum)
spr = spiracles
mp = mouthparts
md = mandible
mx = maxilla
lbm = labium
Insect Antennae

- Clubbed or not clubbed
  - B – filiform
  - D, E – clavate
  - F – capitate
  - G – serrate
  - L – flabellate
  - M – lamellate
  - N – geniculate
Types of Larvae

A = maggot or vermiform larva, Dipteran larva,
B = Coleopteran larva, grub like,
C = Coleopteran larva
D = Coleopteran larva with Urogomphi (sing. Urogomphus). Urogomphi are fixed or mobile processes found on the terminal segments of certain larvae.
E = Coleopteran larva, Dermestid larva,
F = Vermiform coleopteran larva, legless
G = Hymenopteran larva: head capsule, thoracic legs present or absent, prolegs do not have crochets
Moth Larvae
How to use a taxonomic key

- A “KEY” is an identification tool that makes decisions by always choosing between two choices (couplet)
- Each couplet is:
  - Numbered
  - Describes a character or set of characters
- Choose one choice and follow to next couplet
- Continue making choices until specimen is identified
Insect identification keys

How to use an insect key

An insect key is a tool used to determine the species of a given insect. Typically, insect keys are designed as dichotomous, or paired, couplets. A couplet is a choice between 2 options based on a description of a particular feature. Example: Insect size, antennae shape.

A user chooses which option best matches the insect being identified. This choice leads to another couplet. The process continues until the user reaches a final couplet that identifies the insect.

To use the key effectively, it helps if the user understands insect morphology (structure and body parts).

A glossary of insect terms is also available.

Simple and comprehensive keys

The Canadian Grain Commission has 2 keys available:

- A simple key to commonly found adult insects associated with stored grain in Canada
- A comprehensive key to adult beetles found in stored products, including grain, in Canada and worldwide.

Date modified: 201310-01
**Canadian Grain Commission**

**Storage, handling and delivery**
- Manage stored grain
- Identify an insect
- Primary insect pests
- Secondary insect pests
- Eight common insect pests
- Insect identification keys
  - Stored product beetles found in Canada
  - Stored grain pests found in Canada
- Insect pest biology
- Glossary of insect terminology

**Control grain insect pests**
- Insecticides
- Physical

**Manage storage to prevent infestations**
- Causes of infestations
- Prepare grain bins
- Monitor grain temperature and aerate grain
- Monitor for infestations
- Prevent spoilage
- Prevent infestations during fall storage

**Guides**
- Protection of farm-stored grains, oilseeds and pulses from insects, mites and moulds
- Spoilage and heating of stored agricultural products

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**Insect pests with a length greater than 1 mm**

**Moths - Lepidoptera**

<table>
<thead>
<tr>
<th>Is it a moth?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continue to moths</td>
</tr>
</tbody>
</table>

**Not a moth?**

Continue
Length of body 4 mm or less, elytra without wide band of whitish hairs

**Drugstore beetle - *Stegobium panicum***

Last 3 segments of antenna longer than rest of antenna.

Head hidden when viewed from above.

Continue to Drugstore beetle

**Last three segments of antenna shorter than the rest of antenna**

Head visible when viewed from above.

Continue
Primary insect pests

Insects considered as primary pests of stored products can cause damage to stored grains by directly feeding on the grain at some point in their lifecycles. Primary pests will attack grains that are moist and plastic. Whole grain stored at a stable moisture level temperature and relative humidity condition have the least potential for primary pest attack. Primary pests generally feed on grain that is damaged or in a state of decomposition. Damaged grain may have aggregated endosperm that is accessible food for insects and fungi. The presence of primary insect pests often indicates that the grain is not at optimal condition and that moisture and insecticidal treatment is necessary to prevent further damage in quality.

List of primary insect pests

The primary pest list below are arranged alphabetically by order, family, and scientific name. The grain pests are listed in this end of the insects because they are not insects and are considered secondary pests of grain.
### Lesser grain borer

**Rhizopertha dominica (F.)**

#### Classification
- Primary pest: grain feeder
- Order: Coleoptera
- Family: Bruchidae
- Subfamily: Bruchinae

#### Description
- Adults are dark reddish brown and 3 mm long with distinctly shaped, loose 3-segmented club.
- Larvae are white and O-shaped. They are immobile at maturity with dark head capsule.

#### Similar species
- *Lager grain borer* (*Phytoecus granellus*, not found in Canada)

#### Commodities affected
- Nearly all grains, especially wheat, barley, sorghum and rice
- Seeds, dried fruit, drugs, cork, wood and paper products

#### Signs of infestation
- Large amounts of flour
- Tunnels and irregularly shaped holes in commodity
- Sweet odour in the grain

#### Damage
- Damage is distinctive and heavy
- Adults and larvae feed on grain and endosperm reducing kernels to shells of bran
- Adults and larvae also burrow through kernels

#### How to control
- Control grain insect pests

#### Geographic range
- Is found worldwide and across Canada, although it is not common in all provinces
- Is not well established in Canada due to colder climate

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### Video of Lesser grain borer

Select an image to view a larger version.

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### Transcript

Adult lesser grain borers move...
Other Identification Supports

- Reference figures for anatomy
- Figures in keys
- Habitus drawings for species
- Cheat sheets
- Reference specimens
- Glossary
Insect Biology

- Flight
- Temperature
- Aggregation
- Rate of increase
Flight

- Moths can fly – disperse readily within facility
- Many beetle species can fly (most) but some cannot
  - e.g. granary weevil
  - Speed of dispersal reduced if cannot fly
- Low temperature may restrict flight
  - e.g. rusty grain beetle does not fly below 21°C
Temperature

Temperature Effects

- Death in minutes
- Death in a day
- Slower growth
- Maximum growth
- Slower growth
- Death in weeks or months
- Death in days, or months if acclimated
- Death in minutes
Aggregation

- Insects may or may not be evenly distributed
- Often aggregate or congregate close to resources
  - Cause may be food source, temperature optimum
  - Aggregation pheromone
- Rationale for sampling in multiple locations
  - May miss if only one or two samples
  - Practical limitation on number of samples...
Rate of increase
(rates are per 28 days)

- Rusty grain beetle: 60
- Sawtoothed grain beetle: 50
- Granary weevil: 15
- Rice weevil: 25
- Red flour beetle: 70
- Confused flour beetle: 60
Rate of increase of rusty grain beetle

- Assume 200 eggs per female and 21 day generation time
- Day 1: 1 male/1 female
- Day 22: 100 male/100 female
- Day 43: 10,000 male/10,000 female (twenty thousand beetles in a month and a half)
- Day 64: Two Million Beetles (2,000,000)
- Day 85: Two Hundred Million (200,000,000)
S. oryzae 14% mc

- **18 °C**
- **25 °C**
- **29 °C**

**Month**
- 0
- 1
- 2
- 3

**Number of Insects**
- 0
- 1e+5
- 2e+5
- 3e+5
- 4e+5
- 5e+5
- 6e+5
- 7e+5
- 8e+5
- 9e+5
- 1e+6

- 100
- 150,000
- 1,000,000
- 500
CGC Training – Insect Identification

- One day course
- Up to four people per day
- 8:00 – 4:00
- Hands on work with stored product insects