Granary Weevil

Category: LW  
Minimum Life Cycle: 28 days.  
Distribution: Temperate zones; northern distribution; attacks cereal grains.  

Biology:  
  Eggs: Up to 200 per female laid within grains.  
  Larvae: Within grains; can survive at least 10 weeks at 5°C.  
  Adults: Flightless; easily overwinter in unheated buildings and bulk grain.  

Granary Weevil (*Sitophilus granarius*). The granary, rice, and maize weevils feed on both unbroken and broken grain kernels. The granary weevil is unable to fly. It can be easily separated from the rice and maize weevil in the adult stage by the presence of elongated pits on the surface of the thorax, and by the absence of flight wings and colored markings on the wing covers. It is tolerant of low temperatures and cold climates and is seldom found in semitropical areas. This weevil can subsist in nature on acorns (Figure 1).

(Slide and top caption courtesy of ICI Americas, Inc.)

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Rice Weevil

Category: LW  
Minimum Life Cycle: 28 days.  
Distribution: Tropical and temperate areas on cereal grains.

Biology:  
  Eggs: Laid in stored cereal grains and in cereals in the field by flying adults (more prolific than granary weevil).  
  Larvae: Feed in grain.  
  Adults: Also feed; cannot normally overwinter in temperate areas unless grain heats.  

Rice Weevil (*Sitophilus oryzae*). The rice weevil is able to fly, has small round pits on the surface of the thorax, and red to yellow markings on the forewings. It is less tolerant of low temperatures than the granary weevil. It is widely distributed in both temperate and tropical regions where grain crops are grown and also may be found on acorns (Figure 2).

(Slide and top caption courtesy of ICI Americas, Inc.)
Maize Weevil
(with yellow blotches on forewings)

Category: LW
Minimum Life Cycle: 28 days.
Distribution: Tropical and temperate areas on cereal grains.
Biology:

Eggs: Laid in stored cereal grains and in cereals in the field by flying adults (more prolific than granary weevil).
Larvae: Feed in grain.
Adults: Also feed; normally cannot overwinter in temperate areas unless grain heats. Good flyer; larger than rice weevil.

Maize Weevil (*Sitophilus zeamais*). The maize weevil is slightly larger than the rice weevil and has more distinct colored spots on the forewings. It is a stronger flier than the rice weevil. The habits and life cycle are similar to the rice weevil (Figure 3).

(Slide courtesy of Degesch Americas, Inc., and top caption courtesy of ICI Americas, Inc.)
Lesser Grain Borer

Category: LW
Minimum Life Cycle: 25 days.
Distribution: Worldwide; cereal and coarse grains; both adults and larvae are voracious feeders.

Biology:
- Eggs: Up to 500 per female.
- Larvae: Eat into grain and feed on grain dust.
- Pupae: Usually form inside grain.
- Adults: Also feed and are long-lived compared to other stored-product beetle pests.

Lesser Grain Borer (*Rhizopertha dominica*). The lesser grain borer is a small, highly destructive insect that is related to certain wood boring insects. The eggs are laid outside the kernels and young larvae bore inside. Both the larvae and adults are voracious feeders and leave fragmented kernels and powdery residues. The larvae may complete their development in the grain residue. Grain infested with the lesser grain borer has a characteristic sweet and slightly pungent odor. This odor contains the male-produced aggregation pheromone that has been demonstrated to be an effective lure for use in traps. The insect is a strong flier and recently has been discovered in northern areas of the U.S. and in Canada (Figure 4).

*(Slide and top caption courtesy of ICI Americas, Inc.)*

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Larger Grain Borer

Category: LW
Minimum Life Cycle: 25 days
Distribution: Central America, parts of Africa. Thirty-four percent loss in maize after three to six months storage.

Biology:
- Eggs: Laid in stored maize on the cob or bulk maize.
- Larvae: Feed on grain.
- Adults: Feed on grain.

Larger Grain Borer (*Prostephanus truncatus*). The larger grain borer usually is restricted to corn (maize) and does not commonly occur north of Mexico. In recent years, new infestations have occurred in Africa. The insect is larger and darker in color than the lesser grain borer. It is extremely damaging to maize when dried and stored on the cob (Figure 5).

*(Slide and top caption courtesy of GASGA Publication.)*

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Figure 4. Lesser grain borer.

Figure 5. Larger grain borer.

a. Lesser grain borer.
b. Larger grain borer.
c. Larger grain borer (characteristic truncated posterior).
Angoumois Grain Moth

Category: OLI
Minimum Life Cycle: 28 days.
Distribution: Tropical grains (e.g., maize, paddy, sorghum); commonly attacks before harvest.

Biology:
- Eggs: 40 to 150 eggs laid on grain surface.
- Larvae: Bore into grain, staying until pupation.
- Pupae: Form in grain.
- Adults: Non-feeding; short-lived.

Angoumois Grain Moth (Sitotroga cerealella). The Angoumois grain moth is a former pest of crib-stored corn and can infest grain in the field. Modern harvesting and storage procedures have reduced problems with the insect. The moth is sensitive to low temperatures and is not common in the northern section of the United States. The adult moths do not feed (Figure 6).

(Slide and top caption courtesy of ICI Americas, Inc.)

Rice Moth

Category: OLI
Minimum Life Cycle: 42 days.
Distribution: General feeders on rice, cocoa, biscuits, and seeds.

Biology:
- Eggs: 100 to 200 eggs laid near produce.
- Larvae: Spin threads as they feed forming dense webbing.
- Pupae: Found in food.
- Adults: Non-feeding; one to two weeks.

Rice Moth (Corcyra cephalonica). The rice moth is similar in size to the Indianmeal moth, but is much less common. The larvae are general feeders and prefer warm climates (Figure 7).

(Slide and top caption from USDA-ARS Agric. Handbook No. 500.)
Indianmeal Moth

Category: OLI
Minimum Life Cycle: 26 days.
Distribution: Cereals, ground nuts, and dried fruits.
Biology:
Eggs: 100 to 300 eggs laid on or near produce.
Larvae: Spin threads as they feed forming webs; pre-pupal diapause particularly resistant to insecticide treatment.
Pupae: Form in foodstuffs.
Adults: Non-feeding; short-lived.

Indianmeal Moth (*Plodia interpunctella*). This moth is distributed in a wide range of climates, and is found in many types of foods and processing and storage facilities. The larvae are general feeders and the adults do not feed. The larvae produce a dense webbing. The adults have a distinctive forewing pattern with a light-colored base and a distal two-thirds area that may be red to copper colored (Figure 8).

(Slide and top caption courtesy of ICI Americas, Inc.)

Mediterranean Flour Moth (Mill Moth)

Category: OLI
Minimum Life Cycle: One to six months.
Distribution: Temperate areas; attacks cereal products particularly flour.
Biology:
Eggs: Up to 300 eggs laid on or near produce.
Larvae: Particularly favor flour dust; webbing from heavy infestations can choke machinery.
Pupae: Form in the produce from overwintered larvae.
Adults: Non-feeding; short-lived.

Mediterranean Flour Moth or Mill Moth (*Ephestia kuehniella*). The Mediterranean flour moth prefers flour and meal, but also will infest grain and other foodstuffs. The larvae produce extensive and characteristic loose webbing. The adults are an off-white or gray color. The moths are widely distributed throughout both temperate and subtropical climates (Figure 9).

(Slide and top caption courtesy of ICI Americas, Inc.)
Spider Beetle

Category: OLI
Minimum Life Cycle: Two or three generations per year.
Distribution: Worldwide.
Biology:
- Larvae: Feed on most stored commodities, spices, and cereal products.

Spider Beetle (*Ptinus spp.*). As the name implies, spider beetles resemble small spiders. These are unusual insects in many ways. The insects are scavengers and indicate poor sanitation or faulty structures, and generally live in accumulated food residues. There are many species that live worldwide. They commonly live in temperate or cold climates and may require cold temperatures to complete their life cycle. They feed on both vegetable and animal material; however, vegetable material appears to be optimum. Spider beetles are often the only insects active in cold buildings (Figure 22).

(Slide and top caption courtesy of Degesch America, Inc.)

Bean Weevil (Dried Bean Beetle)

Category: OLI
Minimum Life Cycle: Three to four months.
Distribution: Worldwide; on pulses both in store and in the field before harvest.
Biology:
- Eggs: Laid in pods before harvest or among stored seeds.
- Larvae: Enter and feed within one seed.
- Pupae: Form in seed which then shows characteristic “window.”
- Adults: Non-feeding; short-lived.

Bean Weevil or Dried Bean Beetle (*Acanthoscelides obtectus*). Bean weevils, unlike pea weevils, develop on the mature beans in the field and are able to develop in storages. They occur worldwide, but are most common in subtropical areas. They can develop on a range of seeds, from cowpea, broad bean, kidney bean, chick pea, and wild pea. The insect produces a sweet “fruity” pheromone that gives cultures of newly emerged adults a pleasant smell (Figure 23).

(Slide and top caption courtesy of ICI Americas, Inc.)
Vetch Bruchid

Category: NOLI
Minimum Life Cycle: One year.
Distribution: Europe, North Africa, Asia, and the United States where vetch grows. Not injurious to stored grain. Vetch bruchid is black and cowpea weevil is bronze or rusty brown on the back.

Biology:
Eggs: Attached to seed pod of host vetch plant.
Larvae: Feed inside and hollow out inside of vetch seeds.
Adult: Overwinter in vetch fields. Do not reinfest stored products.

Vetch Bruchid (Bruchus brachialis). The vetch bruchid is a bruchid seed weevil that attacks the seeds of several species of vetch plants. The weevil is common in Kentucky and the Carolinas where it can infest 90 percent or hary vetch seeds, although little foliage damage occurs. The adults overwinter in the host fields or in nearby areas where vetch is used for cover crop. After harvest, wheat can be planted. The vetch bruchid can be found in wheat harvested from these fields. The insect has only one generation per year, cannot survive in storage, and is not a pest of wheat or stored products (Figure 24).

(Slide and top caption courtesy of USDA.)

Red and Gray Sunflower Weevil

Category: NOLI
Minimum Life Cycle: One year.
Distribution: Areas with sunflower farming, especially the Dakotas. Not injurious to stored grain. Two species: red and gray sunflower weevil.

Biology:
Eggs: Deposited in immature sunflower seeds in late summer.
Larvae: Develop inside sunflower seeds. Infested seeds are often harvested. Larvae drop from the infested heads and pupate in the soil.
Adults: Emerge the next summer and feed on foliage and pollen. Do not reinfest stored products.

Red and Gray Sunflower Weevil (Smicronyx fulus and S. Soldia-
dus). The red sunflower seed weevil adults are reddish-brown, and the gray sunflower seed weevil are slightly larger and gray in color. The larvae of both species are small, cream colored, legless, and C-shaped in appearance. Seed weevil adults emerge in mid-summer and feed on sunflower buds. As the sunflower matures, the adults feed on pollen, and, as the seeds mature, eggs are deposited within the seed. After developing in the seed, the larvae drop to the ground, overwintering in the soil. The insect is univoltine in North Dakota, cannot survive in storage, and is not a stored-product pest (Figure 25).

(Slide courtesy of D. K. McBride, and top caption courtesy North Dakota Coop. Ext. Service.)
**Bracon hebetor**

**Category:** NOLI

**Minimum Life Cycle:** Egg to adult 9 to 10 days (30°C). Adult female longevity about 23 days. Fecundity: approximately 100 eggs.

**Distribution:** Cosmopolitan associated with stored-product moths. Not injurious to stored grain.

**Biology:**
- **Adults:** Females paralyzed and lay eggs in late instar moth larvae. Each female produces about 100 eggs. On the average, eight larvae develop in one host. (Host: Indianmeal moth and almond moth external to grain.)

*Bracon hebetor,* a Parasitoid. *Bracon hebetor* parasitizes several of the common grain moths such as the Indianmeal moth in the late larval stage. According to the results of laboratory tests, it promises to be a useful biological control agent (Figure 28).

*(Slide courtesy of USDA, J. Brower.)*

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**Anisopteromalus calandrae**

**Category:** NOLI

**Minimum Life Cycle:** Egg to adult 12 days (30°C). Adult female longevity about 70 days. Fecundity: approximately 280 eggs.

**Distribution:** Worldwide. Not injurious to stored grain.

**Biology:**
- Most important natural enemy of *Sitophilus* weevils. Female adults locate weevils inside grain kernels. Female lays eggs inside grain kernel on weevil larvae. Can also attack larvae external to grain. (Host: *Sitophilus* weevils, bruchid bean weevil, cigarette beetle.)

*Anisopteromalus calandrae,* a Parasitoid. This parasitoid has been demonstrated to reduce populations of the maize weevil in stored corn. This small pteromalid wasp is now produced commercially for release in grain bins (Figure 29).

*(Slide courtesy of USDA, J. Brower.)*

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**Figure 28.** *Bracon hebetor* (Parasitoid).

**Figure 29.** *Anisopteromalus calandrae.*
Psocids

Category: NOLI
Minimum Life Cycle: 21 days.
Distribution: North America and Europe. Not injurious to stored grain.
Biology:
Eggs: Up to 100 eggs per female laid on commodities and bags.
Larvae: No larval stage; young resemble adults, but smaller in size and paler in color.
Adults: Some species are winged and other wingless. Feed on a variety of organic matter of plant and animal origin; troublesome due to presence alone and not actual damage.

Psocids (Liposcelis spp.). These soft-bodied insects have no larval state. The young resemble the adults and are smaller and paler in color. Psocids feed on a wide variety of organic matter, both of animal and plant origin. They do not actually damage grain, but are troublesome due to their presence. Eggs are laid on bags and on commodities (Figure 26).
(Slide courtesy of AOM.)

Grain Mite (Cheese or Flour Mite)

Category: OLI
Minimum Life Cycle: 17 days.
Distribution: Worldwide; attacks many types of produce particularly if moisture is high or after fungal attack.
Biology:
Eggs: At least 100 per female; egg stage can tolerate several months at 0°C.
Immature stages and adults: Attack cereal embryos, dormant stage resists starvation, dessication, and chemical treatments.

Grain Mite, Cheese Mite, or Flour Mite (Acarus siro). The body of the grain mite is a white oval with reddish-brown mouth parts and legs. It is widely distributed and endures low temperatures. The grain mite will live in fields, barns, loading areas, and grain elevators, as well as in grain, flour, or other food products that contain sufficient moisture. The mite develops quickly and will cause damage to the grain embryo. The mite leaves a characteristic and mildly pungent odor. Development usually takes place only in grain with a high moisture content (Figure 27).
(Slide and top caption courtesy of ICI Americas, Inc.)
Warehouse Pirate Bug

Category: NOLI

Minimum Life Cycle: Egg to adult 16 days (30°C). Adult female longevity is five to six weeks. Fecundity: approximately 150 eggs.

Distribution: Widespread and common in grain storage. Not injurious to stored grain.

Biology:

Most important predatory insect in grain storage. Nymphs and adults prey on eggs, larvae, and pupae of many species of grain insects.

Warehouse Pirate Bug (*Xylocoris flavipes*). This predator is an anthocorid bug that is commonly found in storages. This insect shows considerable promise as a biological control agent since it preys on moths as well as several important beetle species, such as red and confused flour beetles and sawtoothed grain beetles. This predator also is produced commercially for release in grain bins (Figure 30).

*(Slide courtesy of USDA, J. Brower.)*

Figure 30. Warehouse pirate bug (Predator).