المحاضرة الخامسة

أولاً: حشرات تابعة لرتبة غمدية الأجنحة
Order : Coleoptera

- الحشرات الكاملة جسمها صلب (تضم الخنافس والسوس) واليرقات لا تحتوى على أرجل بطنية كاذبة ولا تغزل خيوط حريرية على الحبوب أو منتجاتها
- سوسة المخزن (سوسة القمح) *Sitophilus granarius L.*
- سوسة الأرز *Sitophilus oryzae L.*
- خنفساء الدقيق الصدئية *Tribolium castaneum (Herbst.)*
- خنفساء الدقيق المتشابهة *Tribolium confusum Duval.*
- خنفساء السورينام *Oryzaephilus surinamensis L.*
- خنفساء الكادل *Tenebroides mauritanicus L.*
- خنفساء الثمار الجافة ذات البقعتين *Carpophilus hemipterus L.*
- خنفساء الثمار الجافة عديمة البقع *Carpophilus dimidiatus Fab.*

Coleoptera
Beetles and weevils

- 600 species representing 34 families are associated with stored products.
- Only a few species are economically important.
- Identification and biology of economically important species.

- تصيب هذه الحشرات الحبوب المخزونة والدقيق والنوعين الآخرين يتخصصان فى إصابة الفاكهة المجففة والخضروات التالفة
- تقسم تبعاً لقدرتها على إصابة الحبوب السليمة أو عدم مقدرتها على ذلك إلى:-
- حشرات الحبوب الأولية: وهى الحشرات التى يمكنها أن تصيب الحبوب السليمة ومنها سوسة الآرز وسوسة المخزن وخنفساء الكادل
- حشرات الحبوب الثانوية: وهى الحشرات التى تستطيع الحياة على الحبوب المجروشة أو الدقيق أو النخالة أو الحبوب بعد إصابتها بحشرات المجموعة الأولى مثل خنافس الدقيق (الصدئية والمتشابهة) وخنفساء السورينام

- **ثانياً: حشرات تابعة لرتبة حرشفية الأجنحة**
- **Or. Lepidoptera**
- **الحشرات الكاملة فراشات Moths واليرقات ذات أرجل بطنية كاذبة وتغزل خيوط حريرية فوق الحبوب المخزونة ومنها فراش دقيق البحر المتوسط *Ephestia kuhniella***
- **تتغذى يرقاتها على منتجات الحبوب كالدقيق والجريش والنخالة**

حشرات تهاجم الحبوب البقولية المخزونة

- وهى خنافس البقول وهى تتبع رتبة غمدية الأجنحة وفيها تضع الإناث البيض على أزهار البقوليات والثمار أثناء وجودها فى الحقل وقبل الحصاد وبعد الفقس تدخل اليرقة الثمرة وتتغذى على مكونات الحبوب أثناء النضج وبعد التخزين وتعذر اليرقات داخل البذور وتخرج بعد ذلك الحشرات الكاملة أثناء وجود الحبوب فى المخازن وقد يستمر التكاثر لبعض الأنواع فى الحبوب بعد التخزين وأهم هذه الأنواع:-
- خنفساء الفول الكبيرة *Bruchus rufimanus Boh.*
- خنفساء الفول الصغيرة *Bruchidius incarnatus Schm.*
- خنفساء اللوبيا *Callosobruchus chinensis L.*
- خنفساء البسلة *Bruchus pisorum L.*

Rice weevil, Sitophilus oryzae

Granary weevil, Sitophilus granarius

- Family: Curculionidae or snout beetles

Weevils

- Worldwide in distribution.
- *S. granarius* – temperate climates.
- Pests of whole grain.
- *S. granarius*: Chick peas, corn, oats, barley, sorghum, buckwheat, and millet.

- Cannot breed in finely ground materials- but can breed in macaroni and noodles and caked milled products.
- Lay eggs within endosperm of kernels.
- Cavity chewed out and egg laid by female into the cavity.
- Gelatinous material is deposited as ovipositor is withdrawn.

- 2 or more eggs/kernel
- cannibalism-1 survives.
- After hatching larva burrows into seed.
- Tunnel size increases.
- 4 instars.
- Pupal cell formed after last instar.
- Newly emerged adults stay within kernel until cuticle is tanned.

S. granarius

- At 21°C, takes 57-71 days from egg to adult emergence at 50-80% RH.
- At 25C and 70% RH – 45 days.
- Females live for 174 days.
- Lay 200 eggs.

S. granarius

- Oviposition is influenced by population density, age, temp., and RH.
- Eggs laid at 17, 21, 25°C = 43, 100, 268, respectively.
- Oviposition = 0.2 – 2 eggs/female/day.
- Egg hatchability = 80%.

S. oryzae

- Oviposition to adult emergence = 35 days at 27C and 69% RH.
- 29.1°C – 25 days.
- Egg hatchability = 75%.
- Each instar duration = 5 days.
- Temperature ranges = 15.2 – 34°C.

S. oryzae

- Developmental period increases if there are >2 larvae/kernel.
- At 29.1°C – 36 days.
- At 1 weevil/50 kernels of wheat = 344-384 eggs/female at 25-29.1°C.
- No eggs laid at 13°C or above 35C and on grain at or below 10% mc.
- Least cold-hardy of the weevils.

- They are usually found in grain storage facilities or processing plants, infesting wheat, oats, rye, barley, rice, and corn.

- Although not often found in the home, sometimes they infest table beans, acorns, chestnuts, birdseed, sunflower seeds, and ornamental corn.
- They are rarely found in macaroni and spaghetti (must have a thing about Italian food).

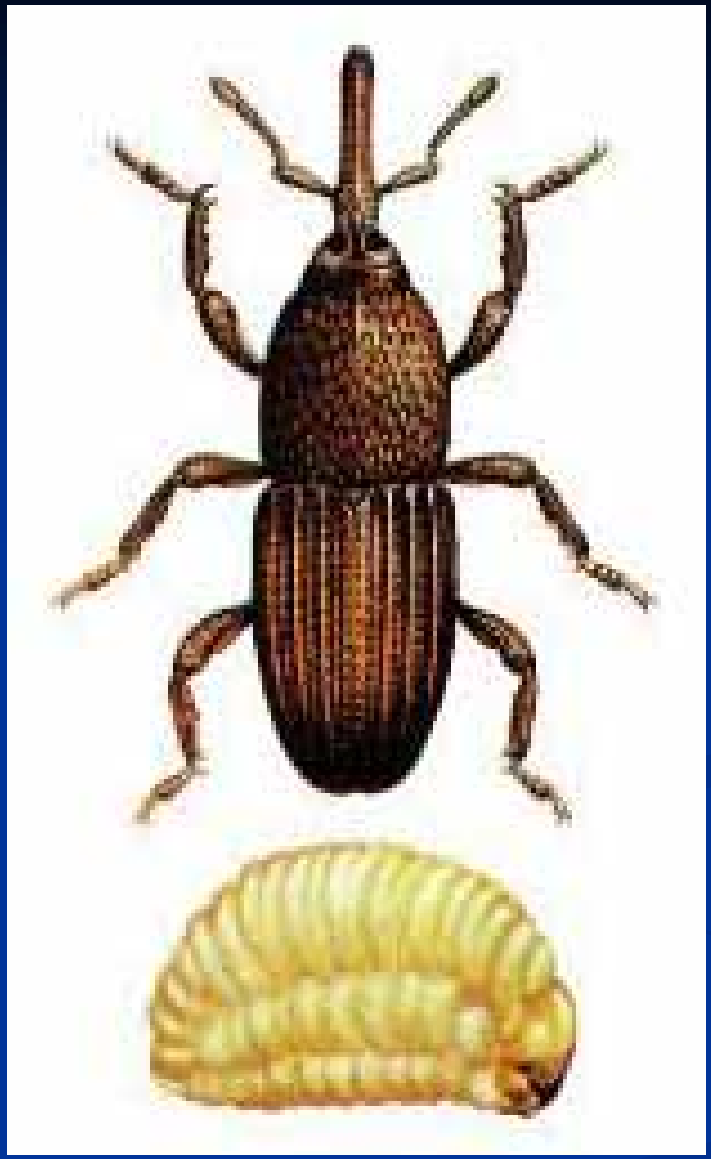
Identification

- Both weevils have chewing mouthparts at the end of their snouts or prolonged heads, and are about 1/8- to 3/16-inch long, depending on the size of the grain kernel.
- In small grains, such as millet or milo maize, weevils are small in size; they are larger in corn.

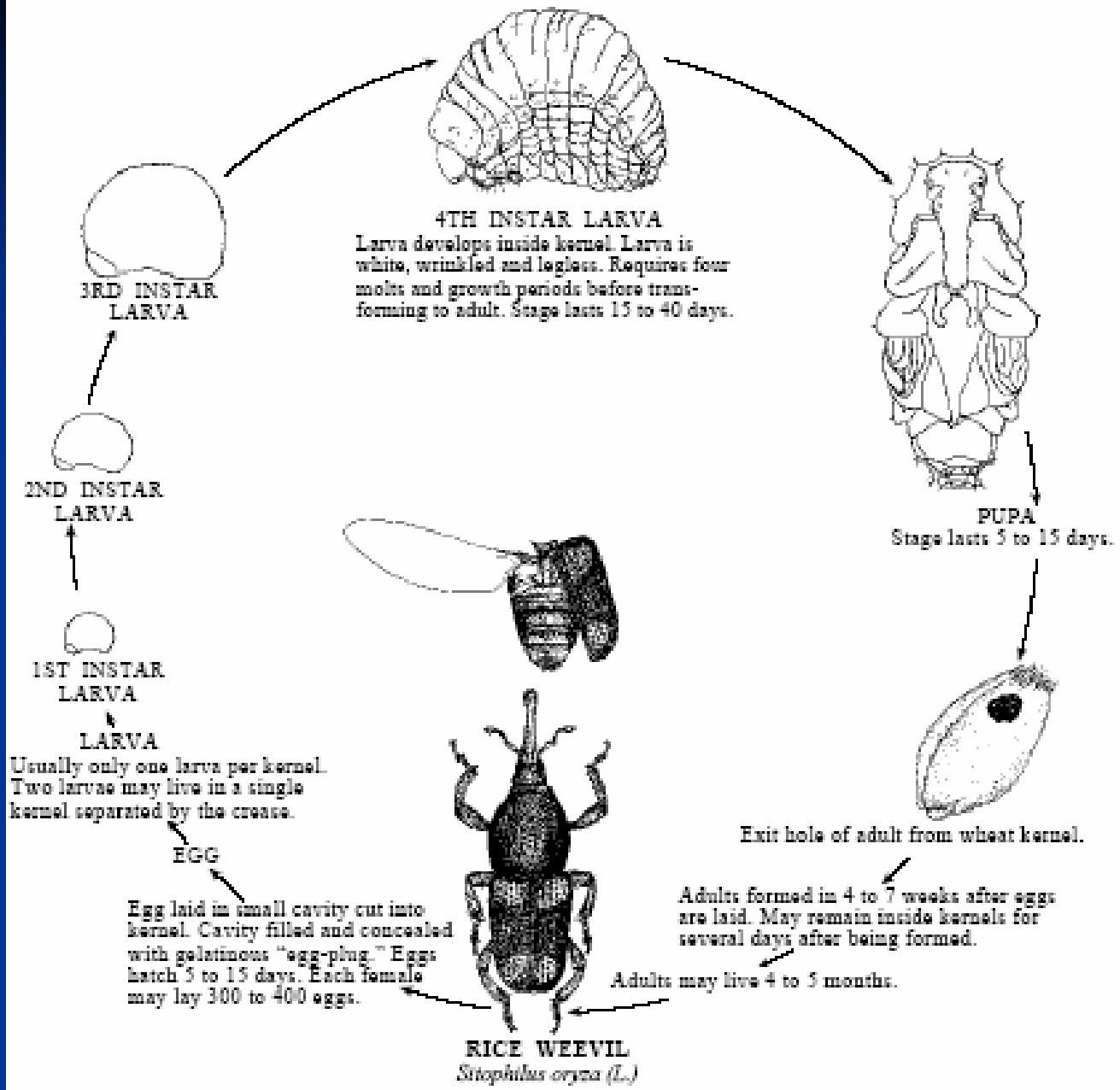
- The adult granary weevil is a shiny reddish-brown with elongated pits on the thorax, whereas the adult rice weevil is a dull reddish-brown with round or irregularly shaped pits on the thorax and four light spots on the wing covers.

- These deep round punctures and light spots are lacking on the granary weevil.
- Also, the granary weevil cannot fly, whereas the rice weevil can fly. Both weevils in the larval stage are legless, humpbacked, white to creamy white, with a small, tan head. Weevils in the pupa stage have snouts like the adults.

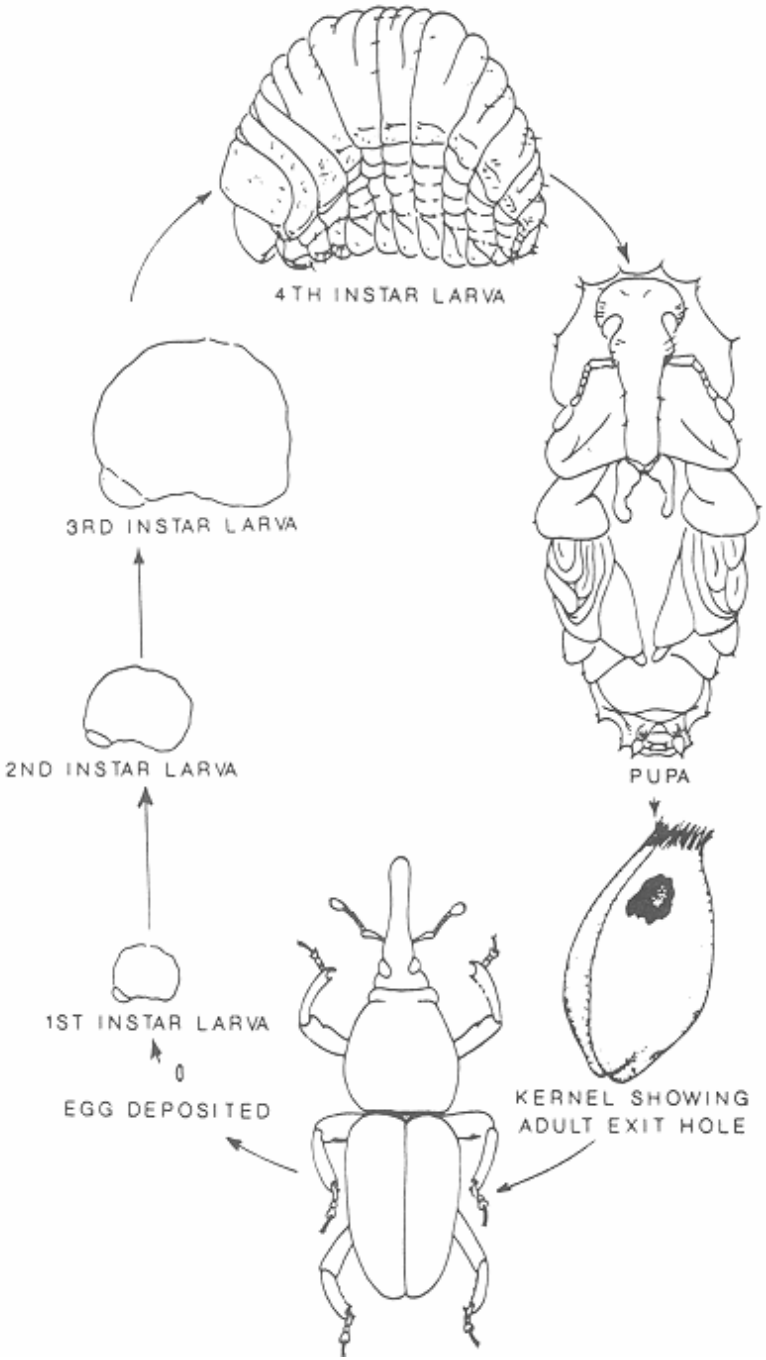

A



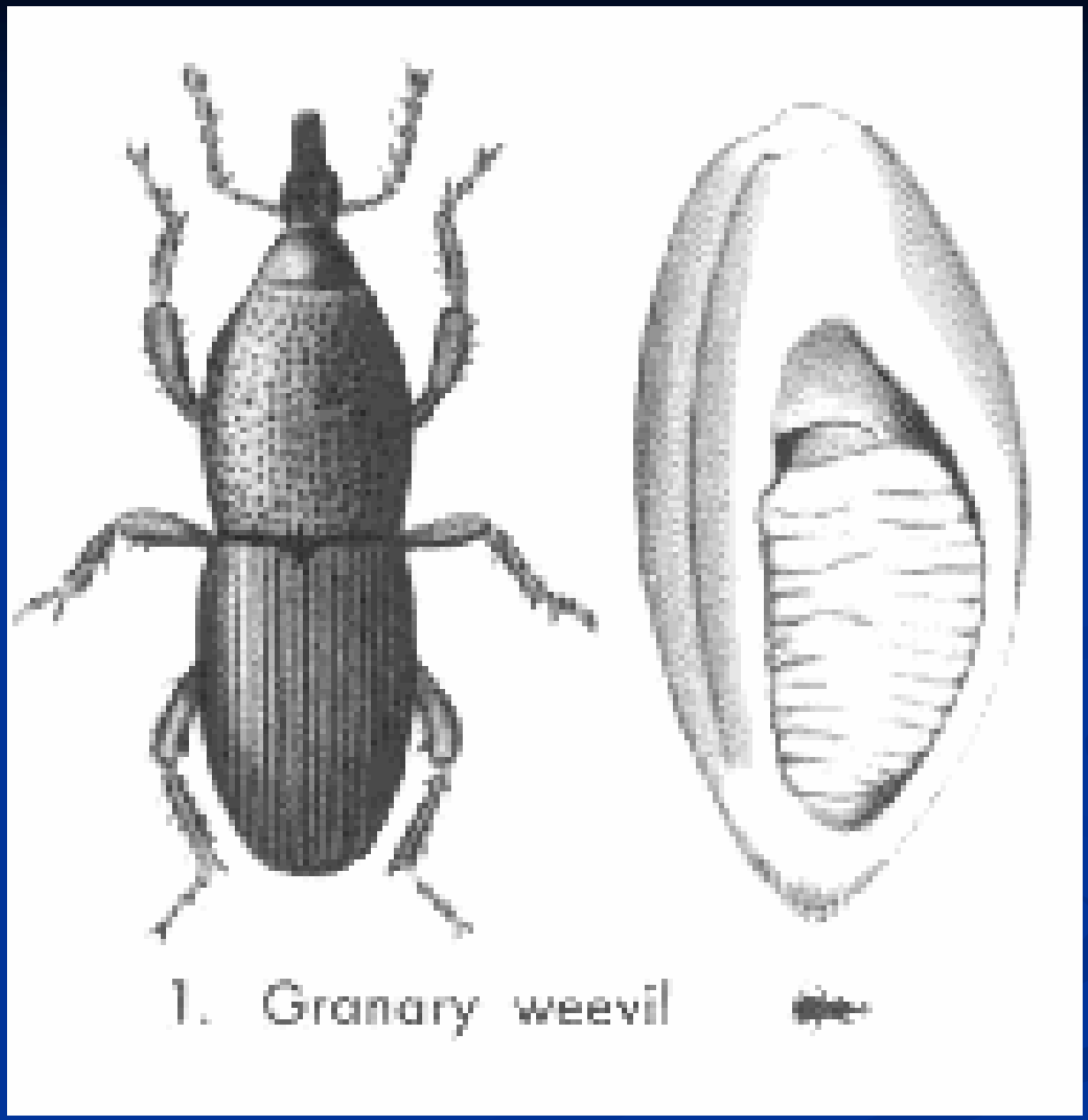
S. granarius



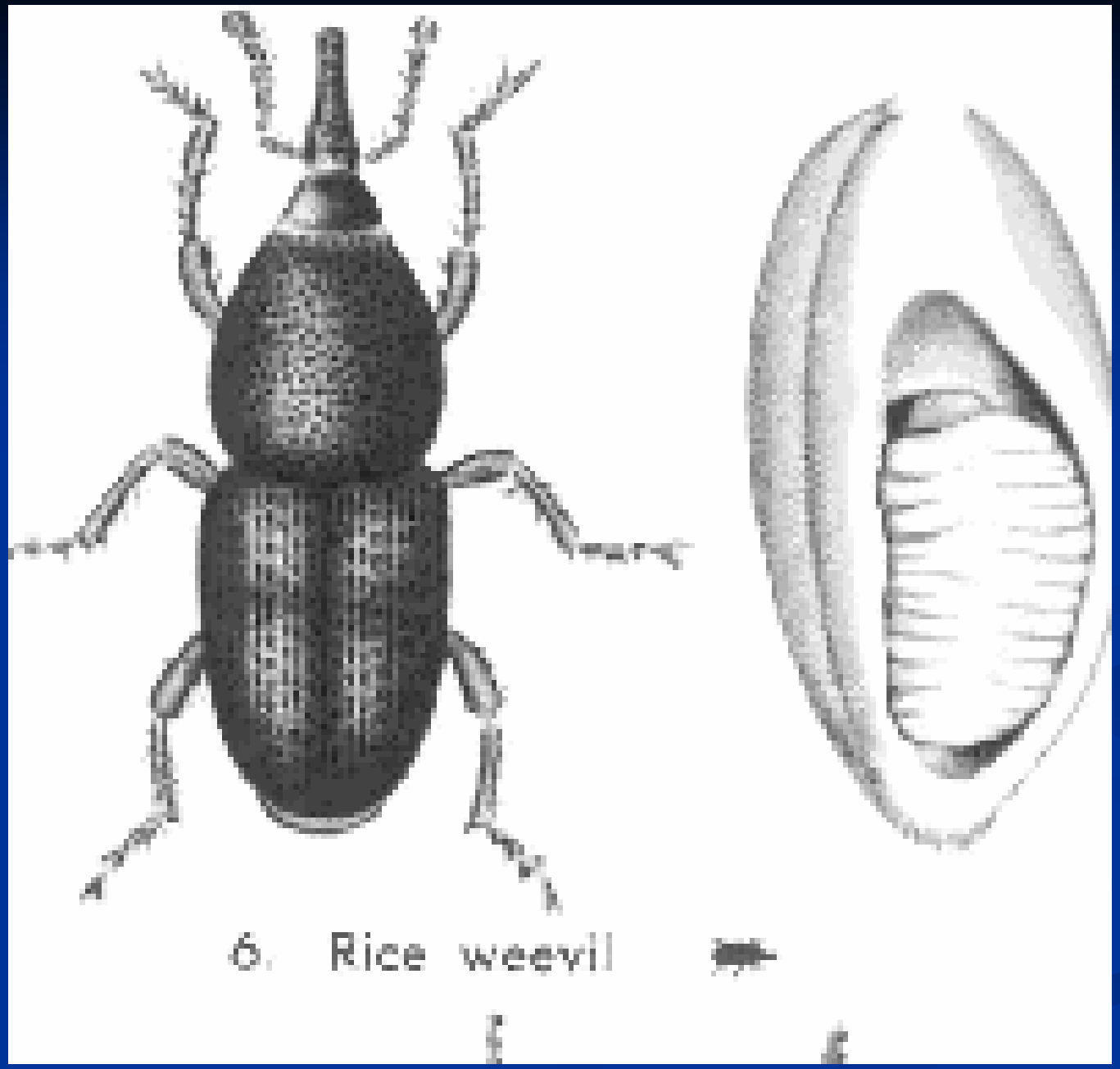
Rice Weevils are reddish-brown to black. They are 1/8 inch long. Two light spots are on each front wing. Body is cylindrical. Head is prolonged into snout. Hind wings function as flight wings.


4TH INSTAR LARVA
3RD INSTAR LARVA
2ND INSTAR LARVA
1ST INSTAR LARVA
EGG DEPOSITED
PUPA
KERNEL SHOWING
ADULT EXIT HOLE


NICE WEEVIL



1. Granary weevil



6. Rice weevil

Lesser grain borer
Rhyzopertha dominica

- The lesser grain borer *Rhyzopertha dominica* belongs to the family of beetles known as Bostrychidae.
- Most of the members of this family are wood boring insects. The adult lesser grain borer has very powerful mandibles and is a voracious and destructive feeder.

- A characteristic feature of a heavy infestation in grain by this beetle is the presence of white flour amongst the commodity caused by its varacious feeding habit.
- Although hot, dry conditions favour the development of the lesser grain borer, the beetle is widespread throughout the world in tropical, sub-tropical and temperate climates, and is the most destructive beetle pest of stored grain.

- **Description**

  Adults: **The adult beetle is small, between 2.5 to 3 mm long, has a distinctive cylindrical shape, and is dark brown to black. The head, tucked underneath the thorax, is invisible when viewed from above.**

- **Life cycle**

  Optimum: **25 days at 34°C, 70% r.h.**

  Range: **20 - 38°C, minimum relative humidity 30%**

  Maximum population growth rate per month: **20 times.**

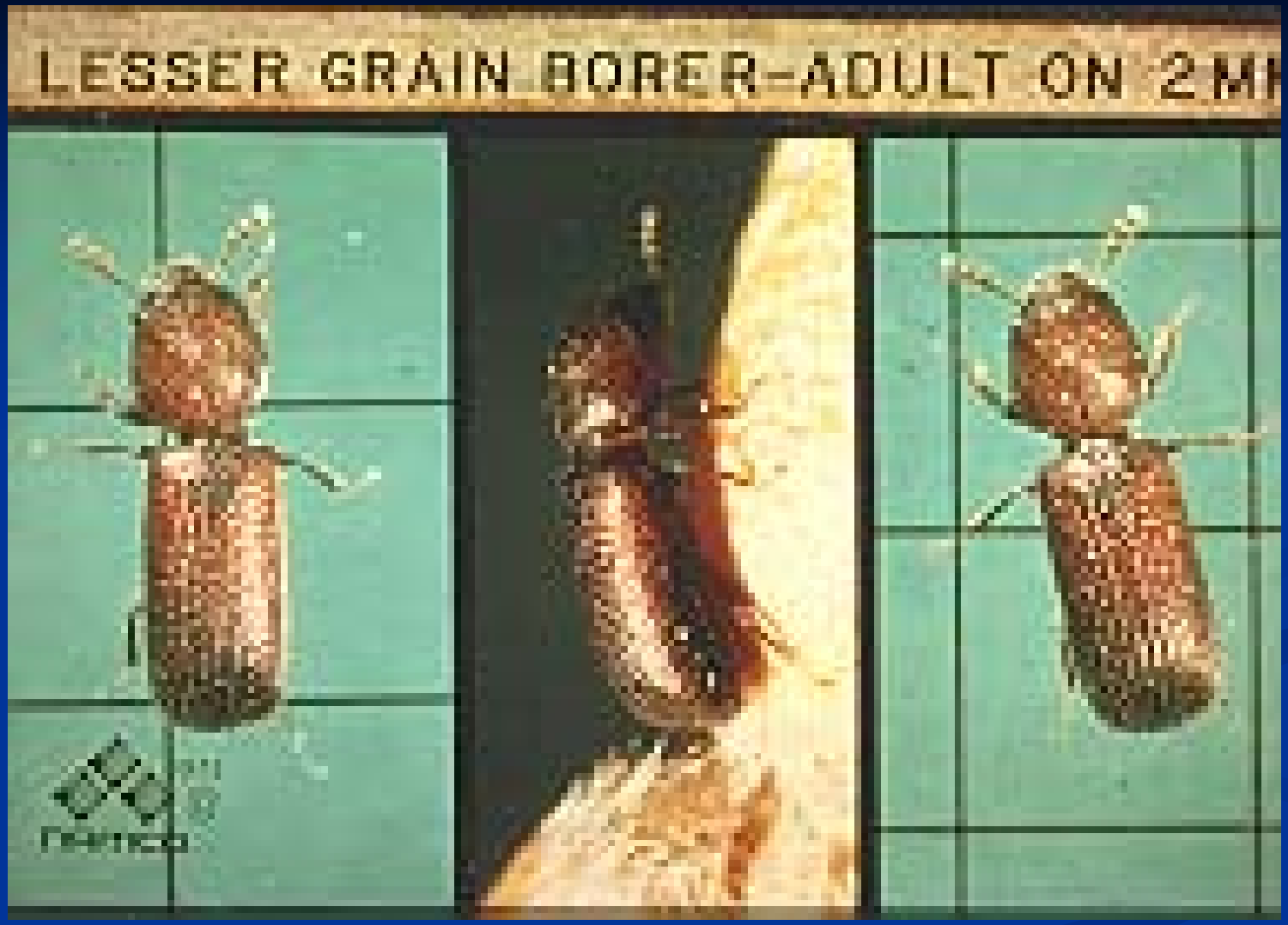
- Biology
  Eggs: Laid in clusters as females actively bore through grains.
- Eggs are laid outside the kernel and young larvae bore into the grain to complete their development. Under optimum conditions the female adult lays up to 500 during its lifespan.
- Eggs laid on stored commodities at moisture levels as low as 8% can still hatch.

- *Larvae:*
- The cream coloured larvae has biting mouthparts and three pairs of legs.
- The young larvae are mobile but become immobile as they complete their development concealed within grain or flour.
- The larvae normally passes through four instar stages during which it size increases.

- All larvae have usually bored into grain (or a suitable hard substrate) by the third instar. *Pupae:* The mature fourth instar enters into an inactive pupal stage within the grain and gradually assumes the form of the adult.

- *Adult:*
- When the pupal stage is completed the newly formed adult emerges from the grain by chewing through the outer grain layers. The adult beetle is long lived and is a strong flier when conditions are warm.
- They are adept burrowers and produce large quantities of flour. They are also capable of chewing their way through many types of packaging materials including jute, waxed paper and some polyethylene films.

Figure 4. Lesser grain borer.


LESSER GRAIN BORER-ADULT ON 2MI

Life Cycle

- **The female lays 300 to 500 eggs, singly or in clusters, in the loose grain. They hatch in a few days.**

- The larvae moult 2 to 4 times. They may feed on the flour produced by the boring of the adults, or may bore directly into kernels that have been slightly damaged.
- They complete their growth within the grain, transform to white pupae, and the adults cut their way out.

- The life cycle takes only a month or two, depending on the temperature.
- The adult lesser grain borers chews grain voraciously causing damage which may facilitate infestation by a secondary pest.

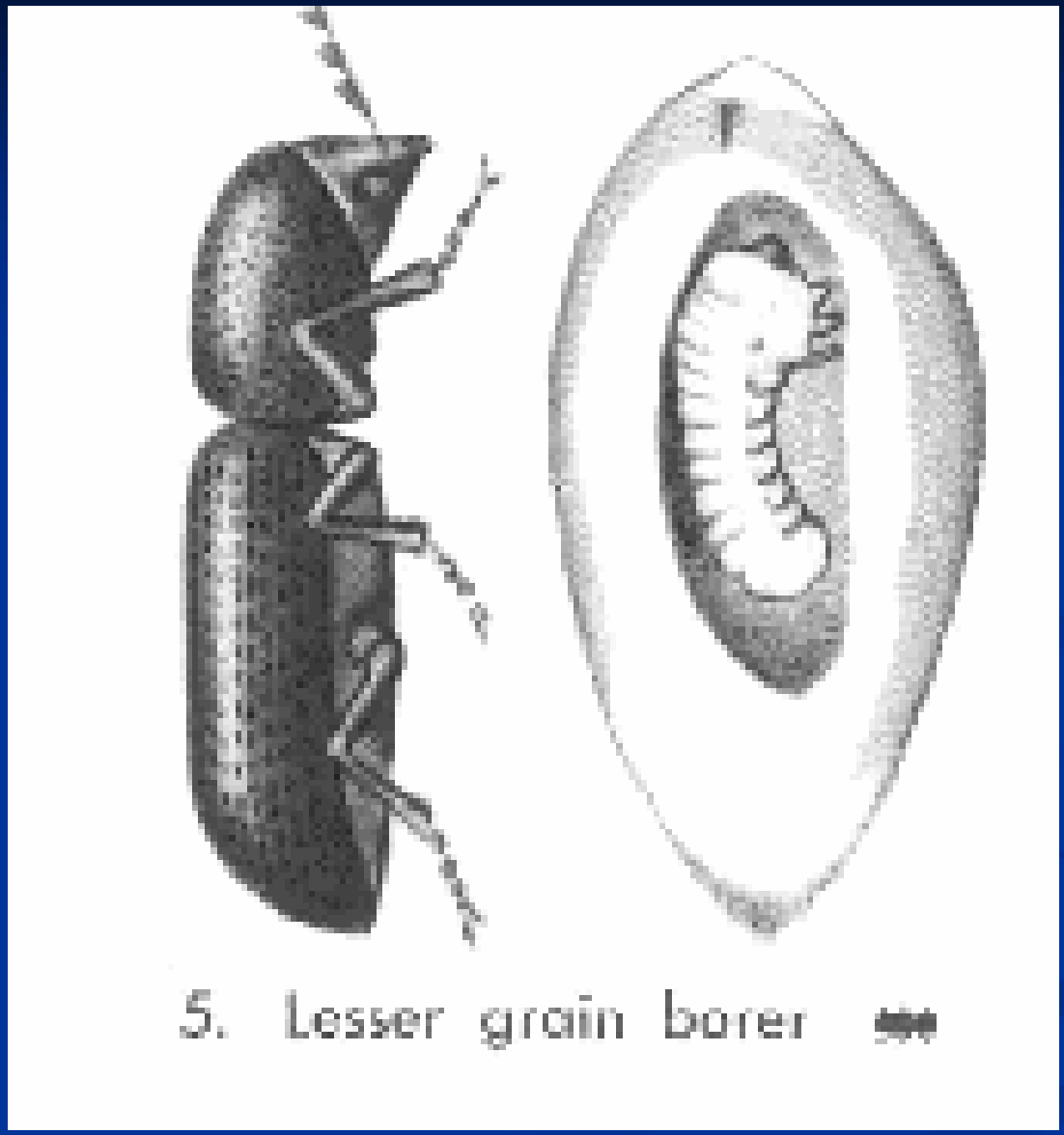
- It is a strong flyer and may rapidly migrate from infested grain to begin new infestations elsewhere.
- The most favorable moisture range for stored grain insects is 12 to 15% (optimum 14 to 15%).
- The lowest moisture content for any survival and reproduction to occur is about nine percent.

- Infests whole cereals and cereal products, chickpeas, pumpkin seeds, dried potato, edible bulbs, wood.
- Oil seeds and spices are unsuitable for larval development.
- Unable to develop on whole pulses; needs broken pulses.
- Sorghum and barley – less satisfactory for development than wheat, rough rice, brown rice and pearl millet.
- Can develop on kibbled wheat.

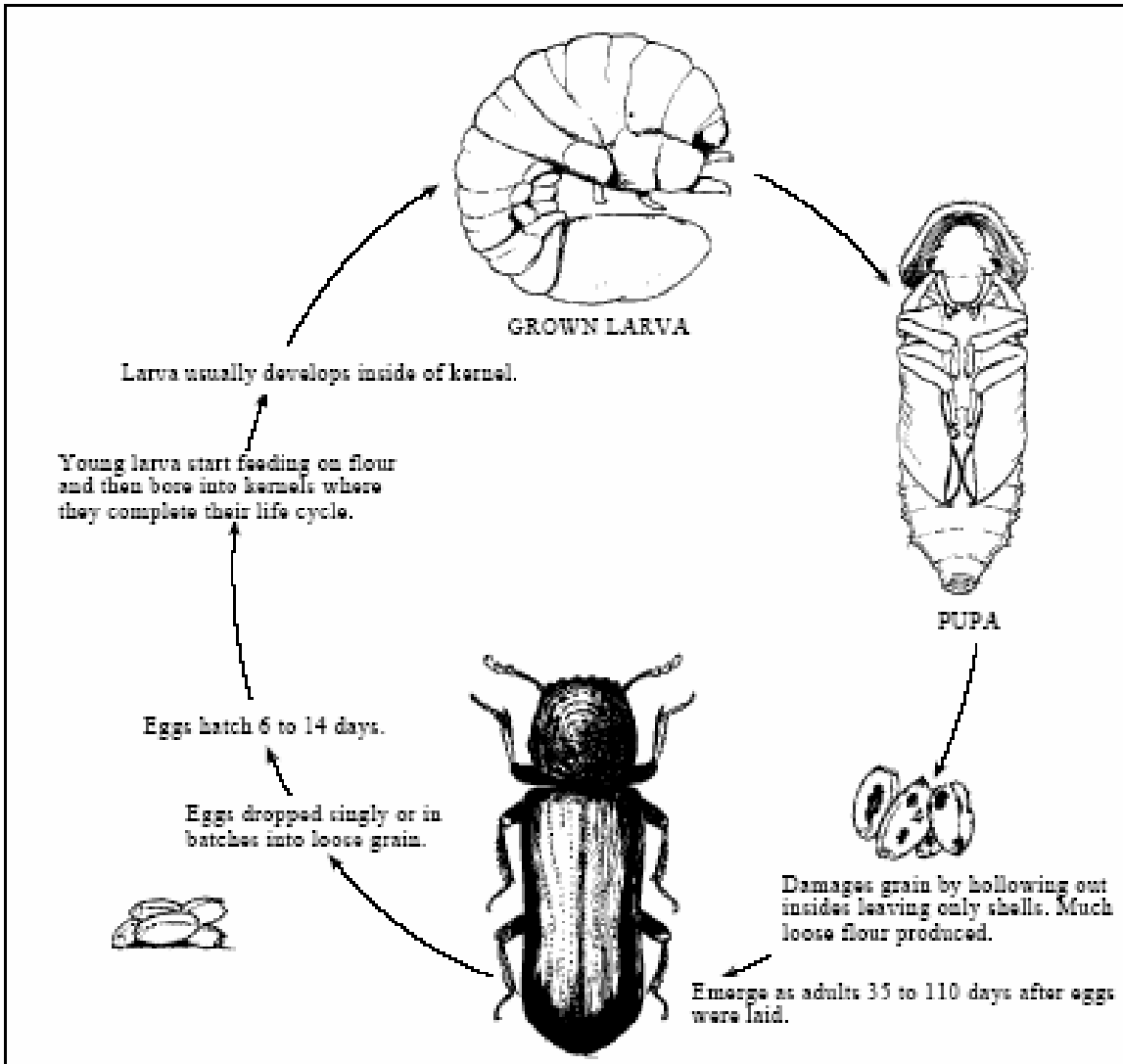
- Population growth is rapid on wheat.
- Eggs laid singly within kernels.
- Larval development rapid on grain than on flour from the same grain.
- First instar burrows into any rift in the seed coat. Third instar incapable of locomotion. 4^{th} and 5^{th} instars similar to 3^{rd}.
- Pupation takes places inside kernel at the end of the larval tunnel.
- Males and females develop at the same rate.

- Temperatures: 18.2 – 38.6°C on 14% moisture wheat.
- Egg-to-adult shortest (25 days) at 34°C.
- Immature mortality is also low (22%) at 34°C.
- 1st instar mortality 53% at 22C and 86% at 38.2°C.
- Development slower on grain < 12% moisture.

- Oviposition increases if there are damaged kernels.
- Fecundity greatest between 26 and 34°C on 9-14% moisture wheat.
- Total number of eggs/female = 415.
- Oviposition period = 112 days.
- Excellent fliers.



5. Lesser grain borer



LESSER GRAIN BORER

Rhyzopertha dominica (F.)

Body is black to brown and cylindrical. 1/8 inch long. Head turned down under thorax. Adult armed with powerful jaws that can cut into wood. Adult is a strong flier. Larvae and adults are both destructive.

The flour beetles, *Tribolium castaneum* and *T. confusum*

- The rust-red flour beetle (*Tribolium castaneum*) and the confused flour beetle (*T. confusum*).
- The flour beetles belong to a large family of beetles known as Tenebrionidae which contains a number of important pests of stored foodstuffs.

- The genus *Tribolium* includes almost 30 species but only two of these are pests in Australia. They are the rust-red flour beetle (*Tribolium castaneum*) and the confused flour beetle (*T. confusum*).
- Both these species are common pests of cereals and cereal products. They will also attack oilseeds and oilseed products and many other commodities.

- They are unable to attack whole grains however there is always sufficient damaged grains in a freshly harvested bulk to support their survival and breeding.
- The confused flour beetle prefers more finely divided commodities than the rust-red flour beetle and is more common in temperate climates, replacing *T. castaneum* in cooler regions in mills and milled products.

- **Distribution:** Worldwide; on many products, secondary on whole grain; red flour beetle more common in tropics than confused flour beetle.

- The red and confused flour beetles are cosmopolitan pests of a wide range of grain, cereal, and other food products, but they prefer milled grain.
- The red flour beetle will fly under certain conditions; however, the confused flour beetle does not fly. The adults are very active, especially in the evening hours.
- These insects produce a foul odor and taste in the food products that they infest, which are caused by pheromones and toxic quinone compounds.

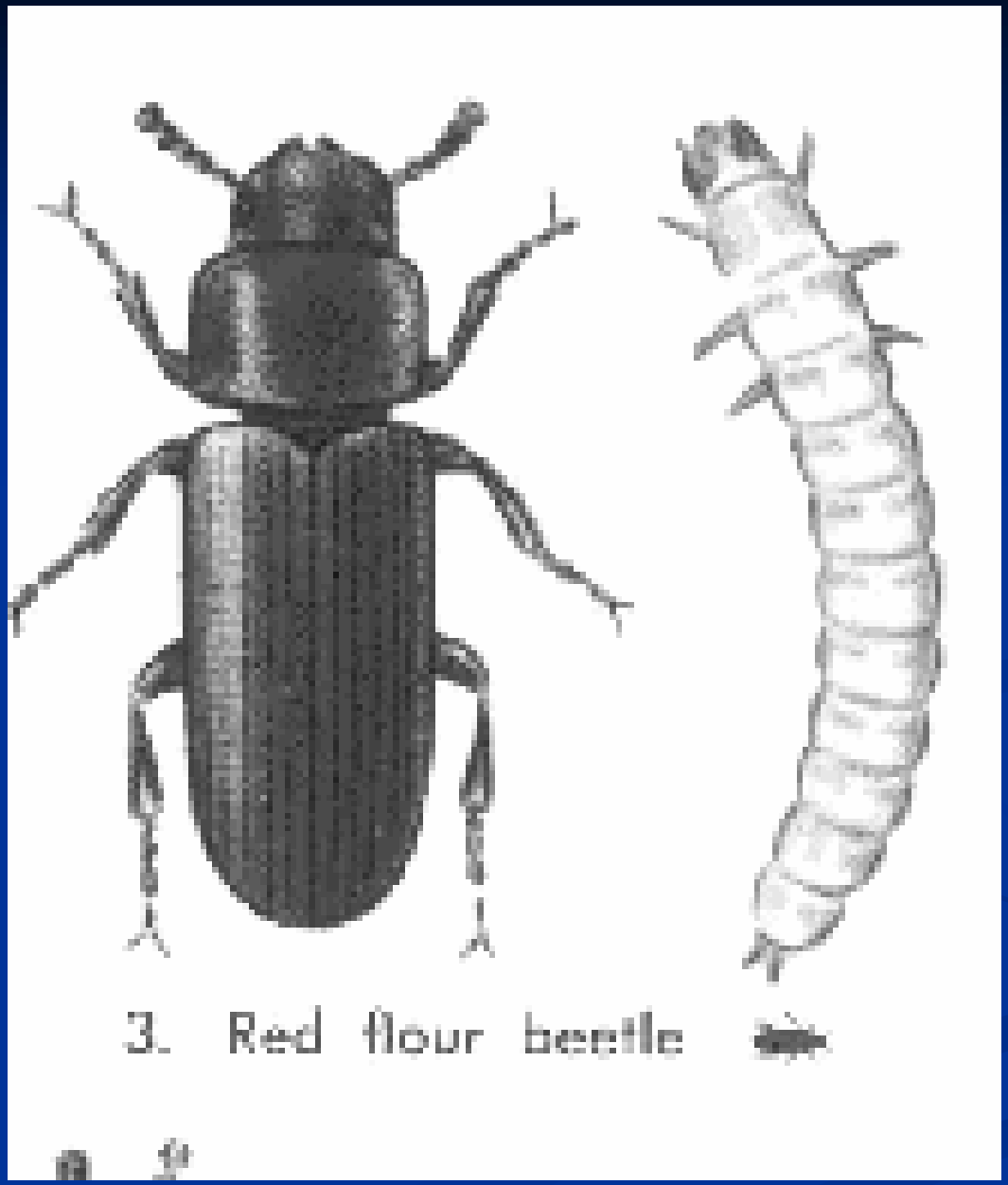
- The eggs, larvae, and pupae are similar in both beetles. Eggs are whitish or colourless and microscopic in size, with food particles adhering to the sticky surface. Brown-headed larvae are cream to yellow, slender, and wiry, reaching a length of 1/4 inch (see picture below of beetles and larvae in flour).
- Larvae have six legs and two-pointed or forked projections at the last rear body segment. Pupae are white to light brown.

- *Life Cycle:*
- Both beetles breed in damaged grain, grain dust, high-moisture wheat kernels, flour, etc. Female beetles each lay 300 to 400 eggs in flour or other foods during a period of five to eight months (two to three eggs per day).
- Within 5 to 12 days, these eggs hatch into slender, cylindrical, white larvae tinged with yellow.
- The length of the larval period varies from 22 to more than 100 days; the pupal period is about 8 days. Fully grown larvae transform to naked pupae, and in a week adults emerge.
- The life cycle requires 7 to 12 weeks, with adults living for 3 years or more. Ideally this type of beetle prefers temperatures of ca. 30°C and will not develop or breed at temperatures lower than 18°C.

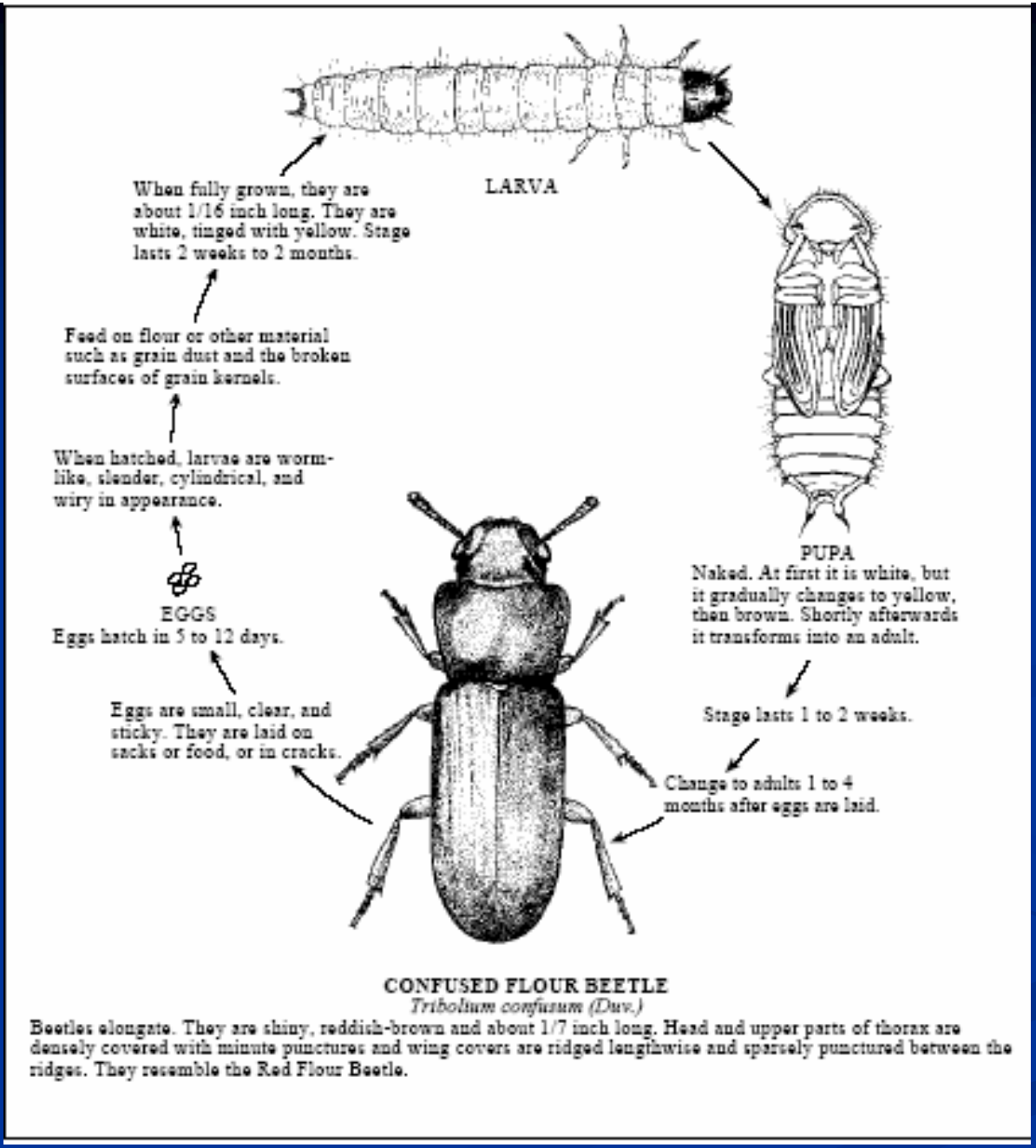
- Description

  Adult: The rust-red flour beetle is between 3 to 4 mm long, flattened, reddish brown in colour and parallel sided. Eyes are crescent-shaped. The confused flour beetle is slightly larger, 4 to 4.5 mm long.
- Although similar in appearance, the confused flour beetle does not have a distinct club formed by the last three segments of each antenna, it has a distinct ridge above each eye, and the eyes are set further apart when viewed from underneath.

- Larvae are elongate, light brown. Major pest of stored products, especially grain and milled cereal products. *T. confusum*
- Life cycle (*T. castaneum*)
  Optimum: 20 days at 35°C, 75% r.h.
  Range: 22 - 40°C, survives very dry conditions
  Maximum population growth rate per month: 70 times



3. Red flour beetle



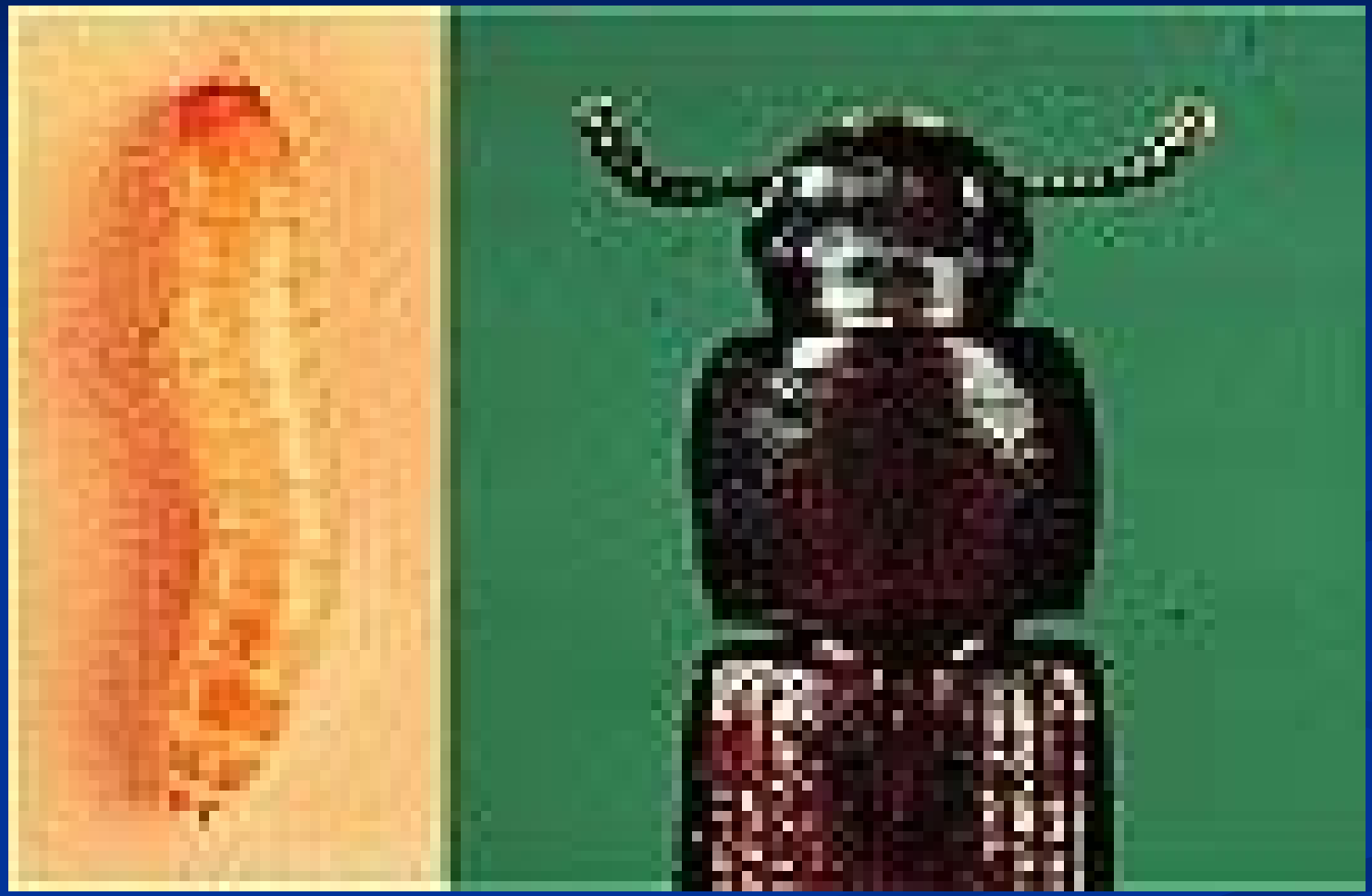
CONFUSED FLOUR BEETLE

Tribolium confusum (Duv.)

Beetles elongate. They are shiny, reddish-brown and about 1/7 inch long. Head and upper parts of thorax are densely covered with minute punctures and wing covers are ridged lengthwise and sparsely punctured between the ridges. They resemble the Red Flour Beetle.

Confused Flour Beetle, *Tribolium confusum*

- *Pupae* - Form in the produce from overwintered larvae.
  Adults - Non feeding; short lived.
- 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



Mediterranean Flour Moth,

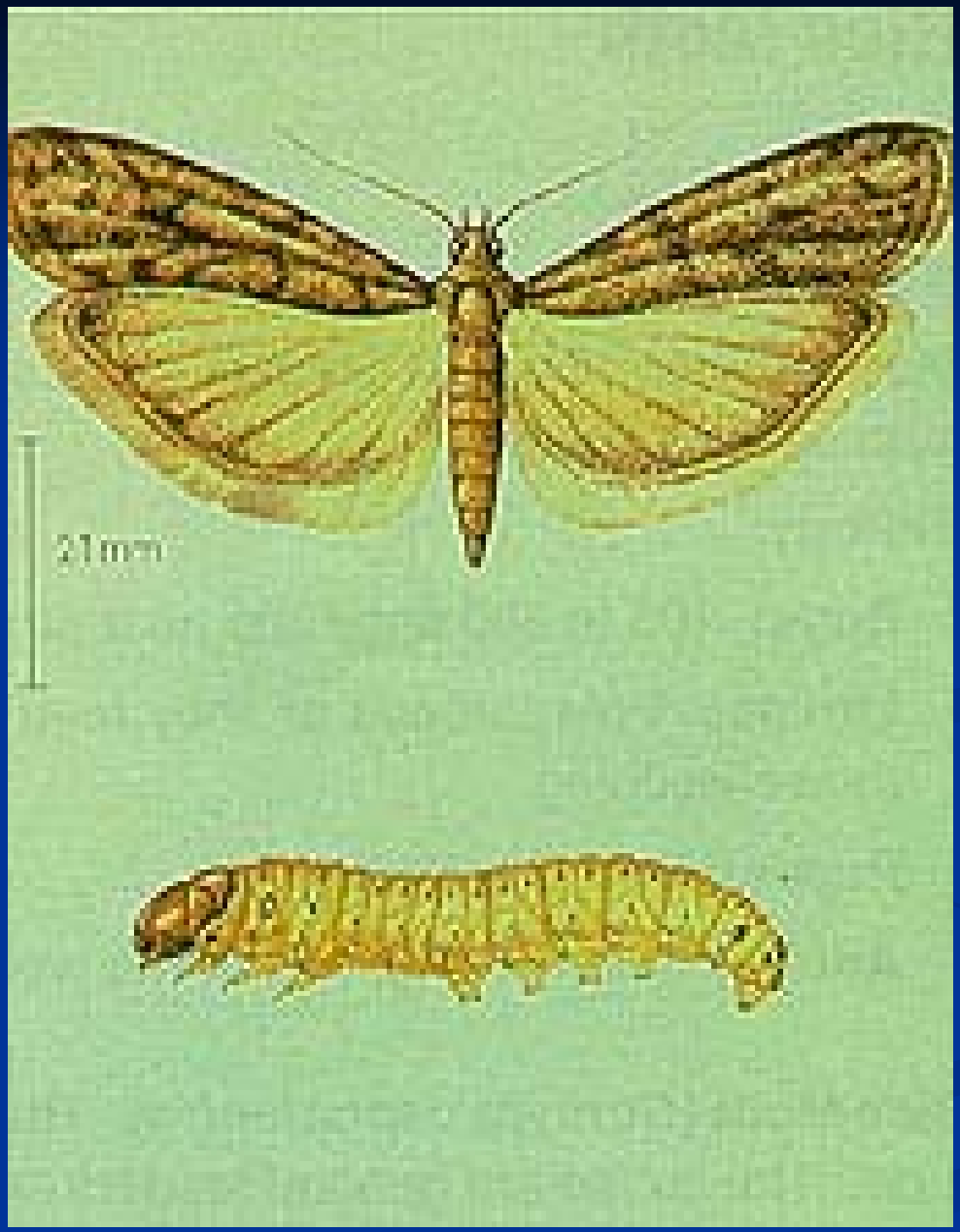
Ephestia kuehniella

- This insect is found worldwide. Depending on temperature and humidity, a single female may lay up to 562 eggs. Optimum temperature is 26؛ C. At 27؛ C temperature, timing for development of a generation varies from 43 to 72 days, and from 140 to 243 days at 10؛ C. It can only develop up to 35؛ C.
- Life cycle takes three to four months, under adequate conditions of temperature and air humidity(70%).

- 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.

- It is generally similar to ***E. elutella***, but larvae become pupae within the food.
- Eggs are laid near the products where they feed. Larvae move quickly, feeding and producing silk, creating webs.

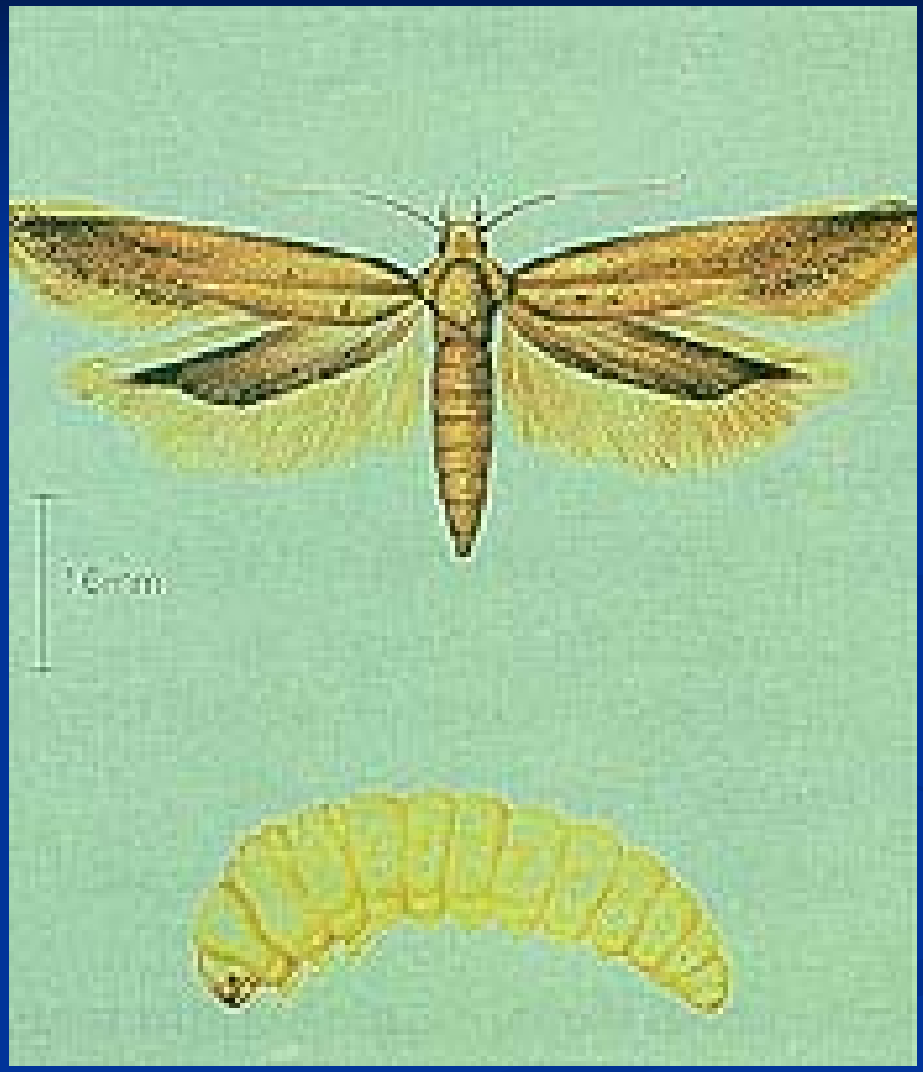
- They grow completely and form pupae within the same products they infest. Silk may form compact masses that may obstruct tubes and shoots in wheat mills, serving as an undercover for other insects that damage grains and stored products.
- Adults are short lived (approximately 14 days), do not feed. They fly more actively at the early morning and late afternoon.

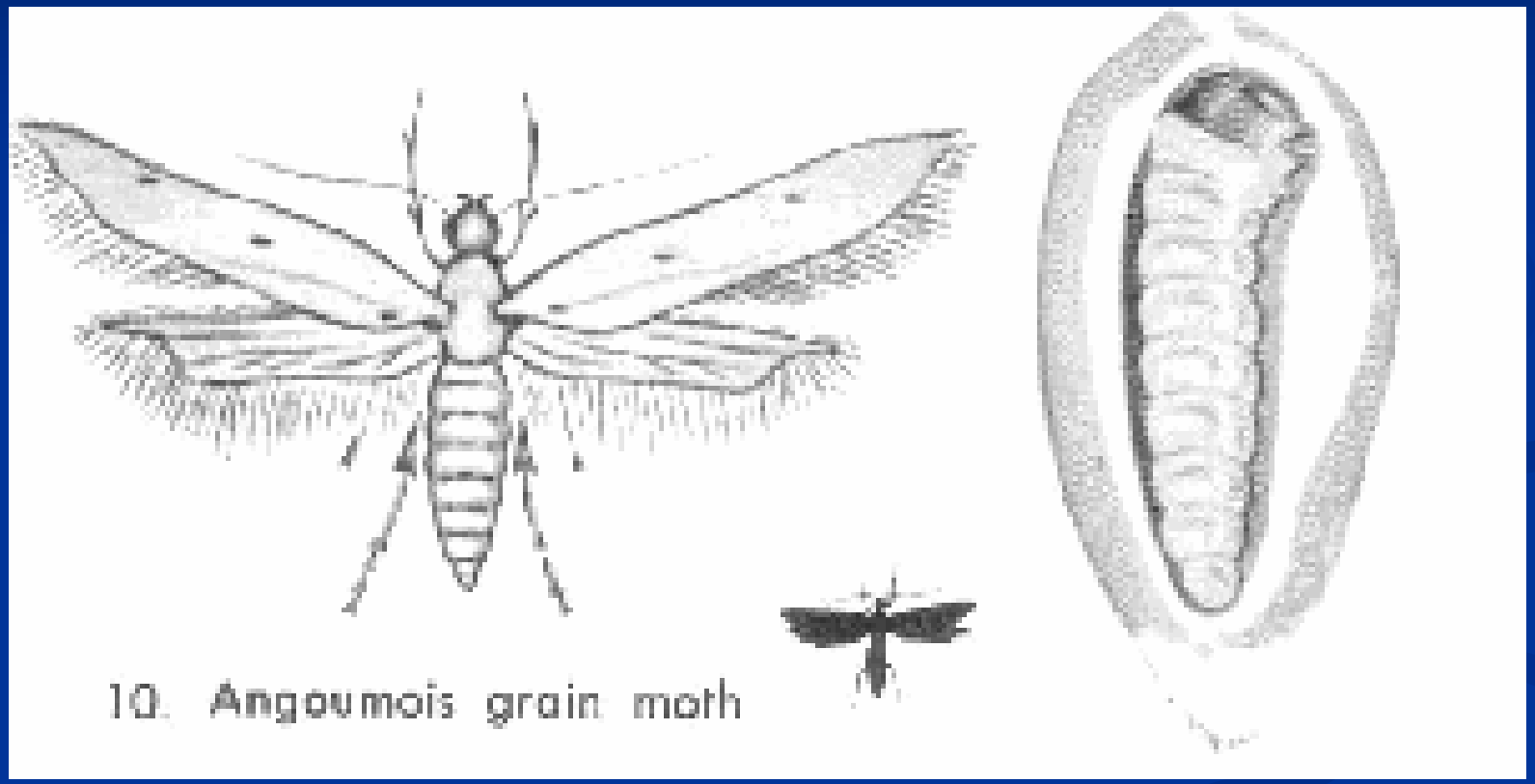

21mm

Angoumois Grain Moth, *Sitrotroga cerealella*

- **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.
- The Angoumois grain moth 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.





10. Angoumois grain moth

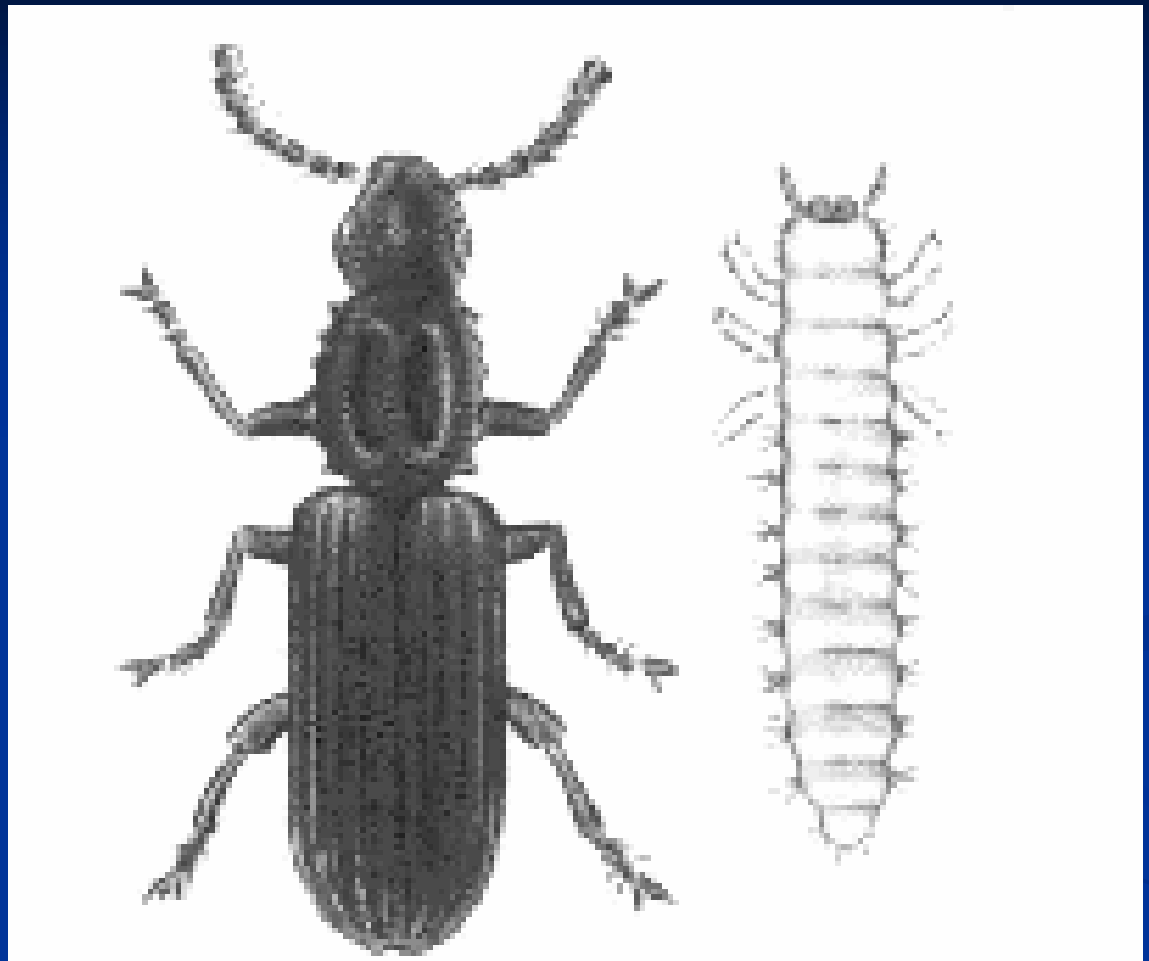
Saw toothed Grain Beetle,

Oryzaephilus surinamensis

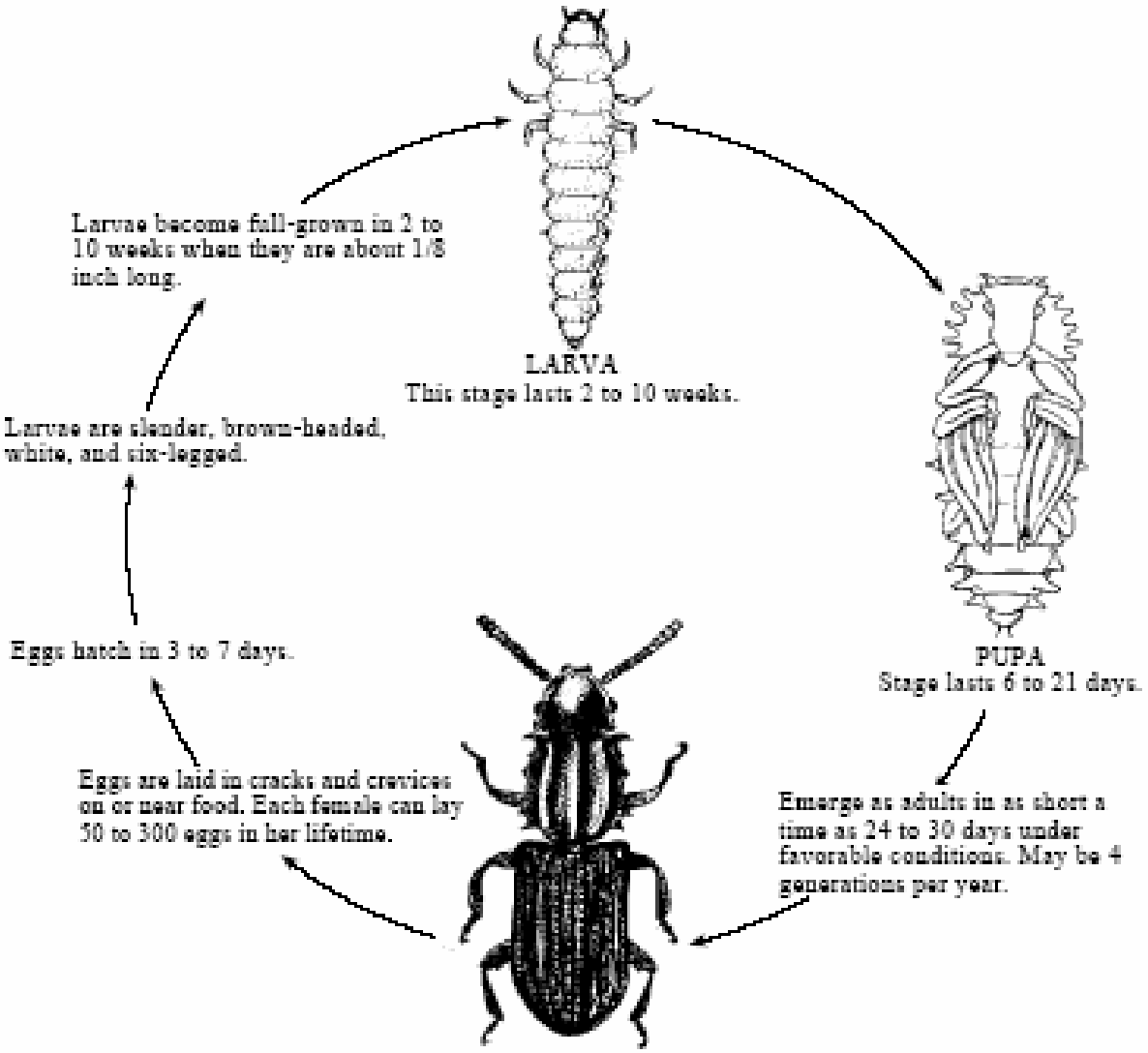
- **Distribution**: important pest of many stored products, secondary pest of whole grain.
  Biology:
  Eggs - Up to 400 per female laid loosely in the grain.

- *Larvae* - Develop rapidly, particularly at high moisture contents (greater than 14 percent).
- *Adults* - Can be long lived, up to three years. The saw toothed grain beetle is one of most common grain and stored-product insect pests.

- It is named after the characteristic saw tooth projections on each side of the adult thorax. It feeds on a wide range of foods—especially milled cereals, dried fruits, candies, and nuts.
- The insect is active and often crawls rapidly in search of food. The saw toothed grain beetle seems to prefer areas of high temperature and humidity



2. Saw-toothed grain beetle



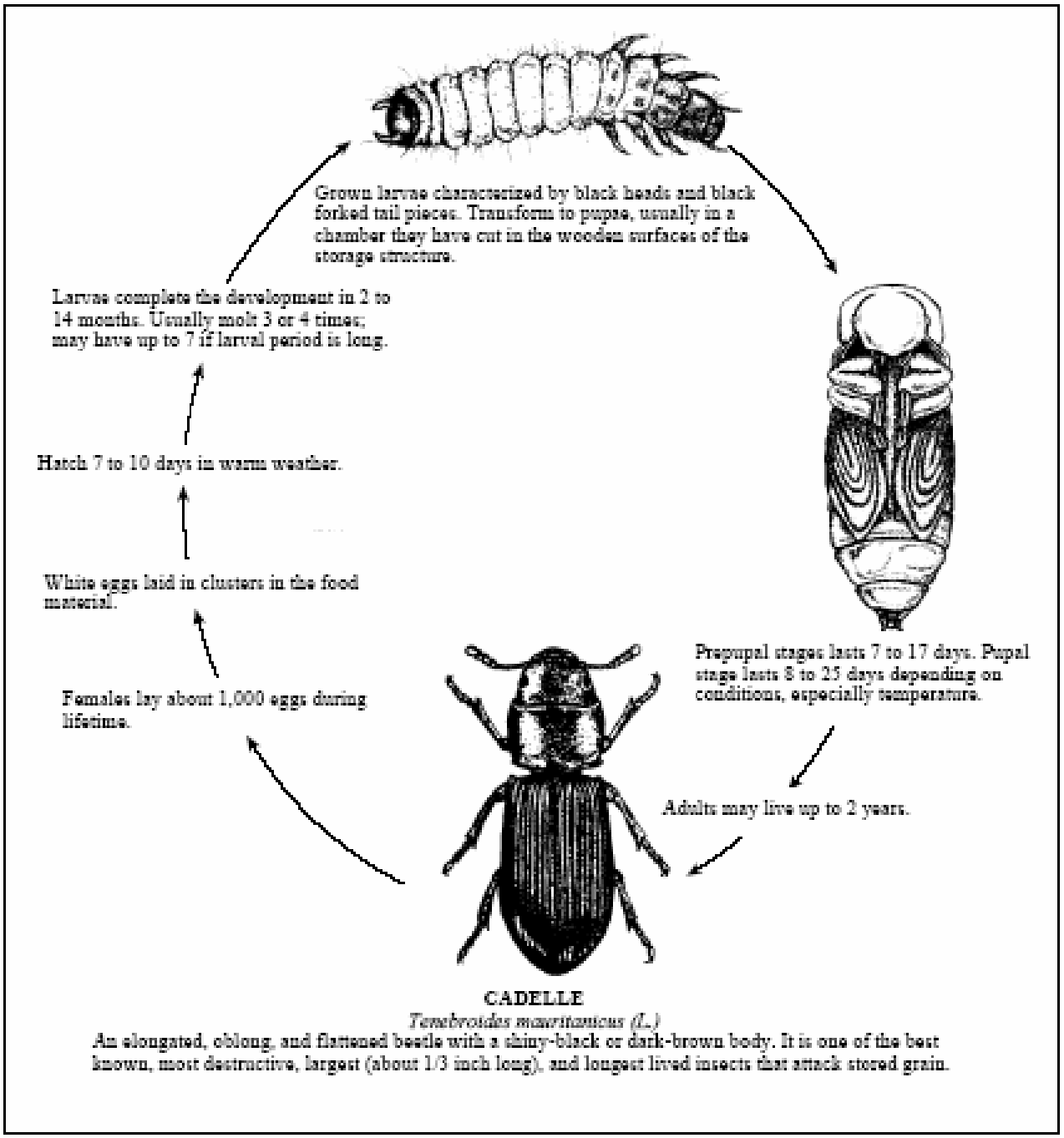
SAW-TOOTHED GRAIN BEETLE

Oryzaephilus surinamensis (L.)

Slender and flat beetles 1/10 of an inch long. Color ranges from dark-brown to red. Sides of thorax have six saw-toothed projections. Adults almost never fly. Adults have been kept alive for over 3 years.


Tenebroides mauritanicus

Tenebroides mauritanicus



طرق المكافحة

عملية تطهير المخازن

- قبل البدء فى عملية رش المخازن لابد أن تجرى عملية تنظيف ميكانيكية وذلك بتنظيف الشقوق وسدها والأسقف والحوائط وقواعد النوافذ والأرضيات ويمكن إستعمال مستحلب زيتى (زيت السولار) الذى يتكون من 100 سم3 زيت سولار – 50 سم3 ماء – 5 جم صابون

التطهير بالحارقة

التطهير بالحارقة

- فى حالة الأجران والشقوق لا يمكن التطهير رشاً أو تعفيراً لأن أرضيتها تحتوى على كمية كبيرة من الأتربة. تتطلب كميات كبيرة من المساحيق أو المحاليل لذلك يفضل إستعمال الحارقات فى هذه الحالة ويجب الإحتياط ضد أخطار الحريق بصفة عامة

إستعمال مواد التبخير

- تعتبر من أنجح الوسائل السائدة لأن الغازات القاتلة للحشرات يمكنها أن تتخلل فى الفراغات التى بين الحبوب والشقوق العميقة فى الجدران وهذا لا يتيسر الوصول إليه بطريقة أو وسيلة أخرى. كما أن الغازات فى الغالب تقتل أطوار الحشرات وهى داخل الحبوب وتظهر نتائجها بسرعة ملموسة ومن أهم مواد التبخير المستعملة: ميثيل البروميد – ثانى كبريتور الكربون – حامض الأيدروسيانيك

شكراً لحضراتكم