

Trogoderma granarium

Introduction

Trogoderma granarium, (Everts) commonly known as the Khapra beetle is native of India (Haines, 1991; Pasek, 1998). This dermestid beetle is the most destructive pest of stored products and grain. According to Pasek, *T. granarium* attacks up to 75 hosts and produces serious losses. The preferred hosts of the Khapra beetle are cereals and oil seeds. This pest is of quarantine importance to the Caribbean where it is not known to occur (Manual de Identificación de Plagas y Enfermedades Exóticas a los Cultivos en la Sub-región Andina 1990).

Identity

Authority	: Everts (1898)
Classification	
Kingdom	: Animalia
Phylum	: Arthropoda
Class	: Insecta
Order	: Coleoptera
Family	: Dermestidae
Genus	: <i>Trogoderma</i>
Species	: <i>granarium</i>
Synonyms	: <i>Trogoderma khapra</i> (Arrow), <i>T. affrum</i> (Priesner) , <i>T. quinquefasciata</i> (Leesberg).
Common names:	Khapra beetle, gorgojo khapra.
Role	: Pest

Signs & Symptoms

The detection of the pest is based on visual inspection of the cast skins from the larvae, excessive dust on the grain (Pasek, 1998; Harris, 1984), and by trapping methods. However, if beetles are not trapped, it does not mean that they are not present (Barak, 1995). Inspections of cargo ships and the examinations of cracks and crevices should be undertaken. The adult and larvae of the beetles must be examined under the microscope to identify them. Pasek (1998) suggests that in stored grain most damage takes place within the first 30 cm. The beetles have also been found along the walls and corners of the grain storage facilities.

Morphology

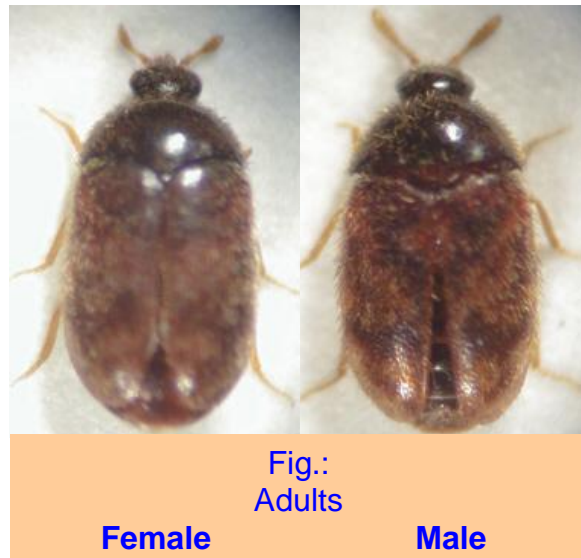
Adult: (Fig. 1) Small, oblong-oval, about 1.8 to 3.0 mm long and 0.9 to 1.7 mm broad, reddish-brown thorax usually dark brown, pubescent. The hairs trap the dust of the destroyed grain giving a dirty appearance.

Female: lighter in color and larger than male. Head small and deflexed with a median ocellus present between the compound eyes; antennae 11-segmented, antennal club very distinct consisting of 3 - 5 segments. The antennae fit into ventral grooves in the prothorax (Haines, 1991; Harris, 1984; Pasek, 1998).

Larva: yellowish to bright brown during the first instar, changing to reddish-brown or golden brown in the last stage; clothed with fine setae, and tufts or/of barbed setae on each side of the terminal abdominal

segments like a tail-shape. The length in the first stages is 1.6 mm reaching up to 6 mm at the final instar. Larvae can feed, but not fully develop on seeds of *Medicago sativa*, *Phaseolus lunatus* (lima bean), and raisins (Pasek, 1998).

Eggs are milky white turning pale yellowish to brown with age, cylindrical, 0.7 by 0.22 mm long with one end rounded and the other pointed, and bearing spine-like projections (Barak, 1995; Haines, 1991; Harris, 1984; Pasek, 1998).



Biology & Ecology

The development of the Khapra beetle varies depending on environmental conditions. The life cycle can range from 26, 166, 220, or 310 days (Haines, 1991; Harris, 1984; Pasek, 1998). However, under optimal temperature (35°C), and moist conditions, the development is accelerated. In addition, the duration of development depends on the kind of stored grain, and light intensity. This pest may have 1 to 9 generations per year.

The eggs which are laid in the host material hatch in 3 - 4 days. A female can lay between 50-90 eggs (40°C), but no eggs are produced below 20 °C. Larval development can occur in 34 days (EcoPort Record), but it takes 18 days at 35 °C, and 73% relative humidity, Haines (1991). The larvae undergo 4 to 8 moults (Pasek, 1998). When the larvae hatch they feed on a wide variety of stored products and dried foods, preferring the whole grains and cereals. Larvae do not develop below 21 °C temperature (Haines, 1991). Pupal development period is 4 - 5 days. Mating occurs instantly after the adult emerges and ovoposition takes place within 6 days. In India 4 - 9 generations per year are produced. In adverse weather, conditions the larvae crawl and go into facultative diapause. Mated females live 4 - 7 days; unmated females can survive 20 - 30 days and a male about 7 - 12 days (Harris, 1984).

Dispersal / vectors

The Khapra beetle is usually dispersed via infested cargo of cereal and grain moving to non-infested areas.

Management

Chemical Control

Pheromone traps are used to attract the beetles. A combination of trap, food attractant and pheromone will help to attract beetles, and allow for the necessary control measures to be adopted. Given its behavior – hiding in crevices and cracks - the beetle is extremely difficult to control using chemical compounds. It requires high dosages of insecticides (Harris, 1984). To control the pest, fumigants like methyl bromide (Barak, 1995; Pasek, 1998) has given good results. However, methyl bromide is deemed harmful for the ozone layer (Pasek, 1998), and has been banned/restricted in some countries.

Other fumigants in use: Carbonyl Sulfide, Phosphine and Carbon Dioxide combinations of 75% to 100% of Carbon Dioxide to Phosphine gas at 30 °C increase the larval mortality of the pest (Pasek, 1998). Harris (1984) mentioned that the Khapra beetle has showed some signs of resistance to some chemicals e.g. phosphine, and malathion.

Natural Enemies

Several natural enemies for *Trogoderma granarium* have been reported. These include: *Amphibolus venators* (Klug) Hemipteran; mites *Acarapis docta* (Berlesse), and *Pyemotes* sp.; the Protozoan *Adelina tribolli* (Bhatia); and the parasitic wasps *Anisopteromalus calandrae* (Howard), *Divarnus basilis* (Rondani) [= *D. laticeps* (Ashmed)], *Holeryris* spp., and *Synopeas* spp. (Haines, 1991).

Host Notes

Pasek (1998)

The Khapra beetle will attack any dried plant or animal matter. It prefers grain and cereal products, mainly wheat, barley, oats, rye, maize, rice, flour, malt, and noodles. It can also feed on animal products such as dead mice, dried blood, and dried insects (Barak, 1995; Harris, 1984; Pasek, 1998).

The main hosts of the pest are as follows -

Avena sativa (oat), *Cicer arietinum* (garbanzo), *Glycine max* (soybean), *Hordeum vulgare* (barley), *Lens culinaris* (lentil), *Oryza sativa* (rice), *Pisum sativum* (garden pea), *Sorghum bicolor* (grain sorghum), *Triticum aestivum* (wheat), *Vigna unguiculata* (cowpea), and *Zea mays* subsp. *mays* (corn).

Preferred animal feeds and concentrates include: rolled and ground barley, ground corn, ground dog food, rolled oats, dried orange pulp, ground rice, and cracked and ground wheat bran. Nuts that may serve as primary hosts include: *Arachis hypogaea* (peanut), *Carya illinoensis* (pecan), *Juglans* sp. (walnut), and *Prunus dulcis* (almond).

Grocery commodities that sometimes serve as hosts include: bread, dried coconuts, cornmeal, crackers, white and whole wheat flour, hominy grits, baby cereals, pearl barley, and wheat germ.

Distribution

Harris, 1984; Haines, 1991, Pasek 1998

Khapra beetle is distributed worldwide.

North America: Mexico (found in the past but not established), United States (found in the past but eradicated in Arizona, California, New Mexico, Texas).

South America: Venezuela.

Europe and Mediterranean region: Established in Algeria, Austria, Cyprus, Germany (found in protected environments, but not established), Israel, Lebanon, Libya, Morocco, Spain, Switzerland, Syria, Tunisia, Turkey (southeastern), United Kingdom (protected environments only). Found but not established in Belgium, Denmark, Ireland, Luxembourg, Netherlands, and Russia. Intercepted only in Hungary and Italy.

Asia: Afghanistan, Bangladesh, India, Indonesia (found but not established), Iran, Iraq, Israel, Japan (restricted distribution), Korean Republic, Lebanon, Myanmar, Pakistan, Saudi Arabia, Sri Lanka, Syria, Taiwan, Turkey, Yemen, China, Korea.

Africa: Algeria, Burkina Faso, Egypt, Kenya (found but not established), Libya, Mali, Mauritania, Morocco, Niger, Nigeria (mainly in north), Senegal, Sierra Leone (intercepted only), Somalia, South Africa (found but not established), Sudan, Tanzania (found but not established), Tunisia, Zambia, Zimbabwe.

Oceania: Intercepted only in Australia and New Zealand.

Pest Significance

The Khapra beetle is the most voracious pest of stored grain products under hot, dry conditions. It can destroy more than 30% of the products (Pasek, 1998), and cause significant losses. The adult beetle does not fly nor feed. It is particularly difficult to control even with pesticides. In addition, because the beetles hide in the stored grain and the larvae diapause for years, the pest can be transported within goods and stored products. The pest is mainly spread through commerce and trade. It can survive for several years without food. The ability to go into diapause increases the capacity to infest and spread into non-infested areas or countries.

Inspection Procedures for the Pest

The Khapra beetle is of quarantine importance to several countries. The most important strategies to introduction of this voracious pest include application of quarantine controls in those countries where this pest is not yet present these preventative measures preventive measures and strict examination/ inspection of cargo from countries where the pest is known to occur.

Bibliography

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Web Resources -

- <http://www.aphis.usda.gov/ppq/>
<http://www.aphis.usda.gov/ppq/>
<http://www.aphis.usda.gov/ppq/>
<http://www.dermestidae.com/Trogodermagranarium.html>