



## Khapra Beetle, *Trogoderma granarium* Everts (Insecta: Coleoptera: Dermestidae)<sup>1</sup>

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### Introduction

The khapra beetle, *Trogoderma granarium* Everts, is one of the world's most feared stored-product pests. In fact, it has been nominated as one of the 100 worst invasive species worldwide (Lowe et al. 2000).

Its discovery in California in 1953 led to a massive control and eradication effort which extended until 1966 and cost the government \$15 million (Kerr 1981). Established infestations are difficult to control because of the beetle's ability to live without food for long periods of time and to survive on foods of low moisture content, its habit of crawling into tiny cracks and crevices and remaining there for long periods, and its relative tolerance to many surface insecticides and fumigants. Therefore, it is important to prevent the khapra beetle's introduction into uninfested areas (Lindgren et al. 1955).

Currently, all infestations discovered in the U.S. have been eradicated. Any possible adults or larvae of this species discovered in the U.S. should be

immediately reported to your state regulatory service (Buss and Fasulo 2006).

### Synonymy

*Trogoderma afrum* Priesner, 1951

*Trogoderma khapra* Arrow, 1917

*Trogoderma quinquefasciata* Leesberg, 1906

(From Herrmann)

### Distribution

Accurate distribution records for the khapra beetle are difficult to obtain, because admission of its presence in a country may result in trade restrictions being imposed (Banks 1977). Its endemic zone extends from Burma to west Africa and is limited by the 35° parallel to the north and the equator to the south. It has been introduced by commerce into some areas of similar climatic conditions (Anonymous, 1981). Lindgren et al. (1955) stated that, except for South America, the khapra beetle is now found in all continents where grain and grain products are stored. However, Szito (1 August 2006) reports that this

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**Figure 1.** Adult khapra beetle, *Trogoderma granarium* Everts. Credits: S. Weingarten, University of Florida

species is not found in Australia (intercepted only) and New Zealand (formerly present, but eradicated).

In the U.S., the khapra beetle was discovered in California in 1953. However, it was later determined to have been introduced as early as 1946 in a warehouse in Fresno, California (Beal 1956), and possibly to have been in the San Joaquin Valley since 1939 (Anonymous 1962). Before its discovery in 1953, it had spread to parts of Arizona, New Mexico, Texas, and Baja California, Mexico. After "eradication" in these areas the khapra beetle was found in a New Jersey warehouse in 1968 and again in 1980 in isolated infestations from 1980 to 1983 in California, Maryland, Michigan, New Jersey, New York, Pennsylvania and Texas (Anonymous 2006).

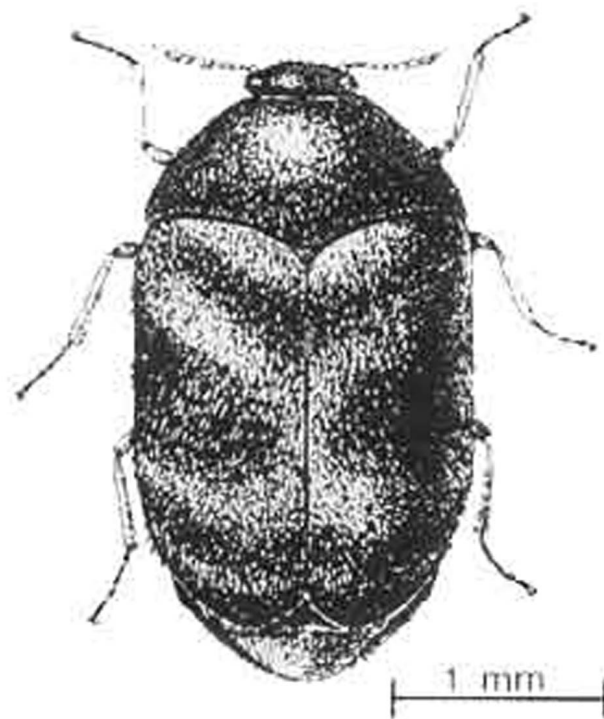
The 1980-1983 infestations were spread by shipment of infested commodities to warehouses in California, Pennsylvania, and Texas. Eradication efforts in these infested states were started

immediately (Kerr 1981). Although not established in Florida, the khapra beetle is sometimes intercepted at ports of entry here and in other states.

USDA-APHIS estimates that 67% of the continental US would have a suitable climate for *T. granarium* (French Venette 2005).

## Identification

**Adults:** The adults are oblong-oval beetles, approximately 1.6 to 3.0 mm long by 0.9 to 1.7 mm wide. Males are brown to black with indistinct reddish brown markings on elytra. Females are slightly larger than males and lighter in color. The head is small and deflexed with a short 11-segmented antennae. The antennae have a club of three to five segments, which fit into a groove in the side of the pronotum. The adults are covered with hairs (Buss and Fasulo 2006).



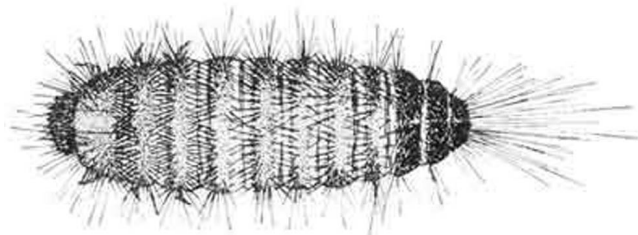
**Figure 2.** Adult. Credits: DPI - from Anonymous 1962

**Eggs:** The eggs are milky white, turning pale yellowish with age, cylindrical, 0.7 by 0.25 mm, one end rounded, the other pointed and bearing spine-like projections.



**Figure 3.** Adult, larva, and larval skins of the khapra beetle, *Trogoderma granarium* Everts, and the damage caused by the larvae. Credits: Anne-Sophie Roy, European and Mediterranean Plant Protection Organization; [www.invasive.org](http://www.invasive.org)

**Larvae:** The larvae at hatching are approximately 1.6 to 1.8 mm long, more than half of this length consisting of a tail made up of hairs on the last abdominal segment. Larvae are uniformly yellowish white, except head and body hairs are brown. As the larvae increase in size, their body color changes to a golden or reddish brown, more body hairs develop, and the tail becomes proportionally shorter. Mature larvae are approximately 6 mm long and 1.5 mm wide.



**Figure 4.** Late instar larva - tail to right. Credits: DPI - from Anonymous 1962

Larvae bear characteristic body hairs: (1) simple hairs in which the shaft bears many small, stiff, upwardly directed processes, and (2) barbed hairs with a constricted shaft in which the apex is a barbed head as long as the preceding 4-segmented-like constrictions (Hadaway 1955, Anonymous 1981).

## Biology

Adult khapra beetles have wings, but apparently do not fly and feed very little. Mated females live

from four to seven days, unmated females from 20 to 30 days, and males from seven to 12 days.

Mating occurs about five days after emergence, and egg laying begins almost immediately at 40°C. Egg laying may begin at one to three days at cooler temperatures, but no eggs are produced at 20°C. Eggs hatch in three to 14 days after the female lays an average of 50 to 90 eggs that are loosely scattered in the host material. Complete development from egg to adult can occur from 26 to 220 days, depending upon temperature. Optimum temperature for development is 35°C. If the temperature falls below 25°C for a period of time or if larvae are very crowded, they may enter diapause. They can survive temperatures below -8°C. In diapause, the larvae can molt but are inactive and may remain in this condition for many years (Anonymous 1981).

Development can occur at a relative humidity as low as 2%. In comparison, high relative humidity may be the limiting factor in the survival of khapra beetles in introductions (Howe and Lindgren 1957). In humid climates, it does not compete well with other better adapted species (Anonymous 1981).

Larvae feed on a wide variety of stored products and dried foods. They prefer whole grain and cereal products such as wheat, barley, and rice, but larvae have been recorded on the following: oats, rye, corn, dried blood, dried milk, fishmeal, ground nuts, flour, bran, malt, flax seed, alfalfa seed, tomato seed, pinto beans, blackeyed cowpeas, sorghum seed, grain straw, alfalfa hay, various nut meats, spaghetti, noodles, cottonseed meal, dried fruits, lima beans, coconuts, garbanzos, hominy grits, lentils, dried orange pulp, peanuts, powdered yeast, wheat germ, and many others (Lindgren and Vincent 1959, Lindgren et al. 1955).

## Economic Importance

*Trogoderma granarium* is a serious pest of stored products under hot dry conditions. Reproduction may be so rapid that larvae are found in large numbers in the surface layers of binned grain. Its discovery in a non-infested area usually leads to an immediate quarantine of suspected goods and an expensive eradication and control effort. This beetle has never been observed to fly; therefore, its spread is probably

dependent on movement of infested goods or in containers where it may be transported while in diapause.

## Detection and Management

The obvious signs of a khapra beetle infestation are the larvae and cast skins. However, the larvae look very similar to those of other relatively unimportant *Trogoderma* species, as well as some carpet beetles. Larvae and adults are best identified by microscopic examination. USDA-APHIS inspects cargo ships and cargo from khapra beetle infested areas and warehouses containing such cargo. Detection methods include examination of cracks and crevices and inspecting behind paneling on walls and under timbers, tanks, shelves, etc. Larvae are most likely to be seen just before dusk, since they tend to be more active at that time (Anonymous 1981).

Some fumigants give control at high dosages, even though this beetle is more resistant to fumigants than most stored product pests. High concentrations of fumigant must be maintained over the fumigation period to allow penetration into all cracks and crevices. In an eradication program, both fumigants and surface sprays are used in combination with preventive measures, e.g., good sanitation practices and exclusion.

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