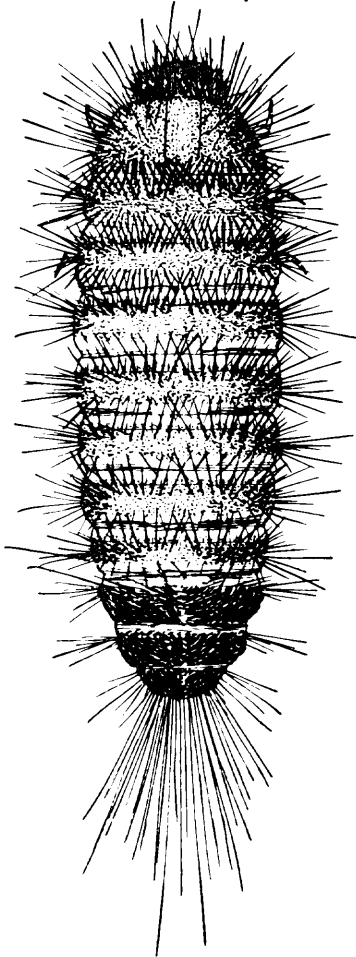
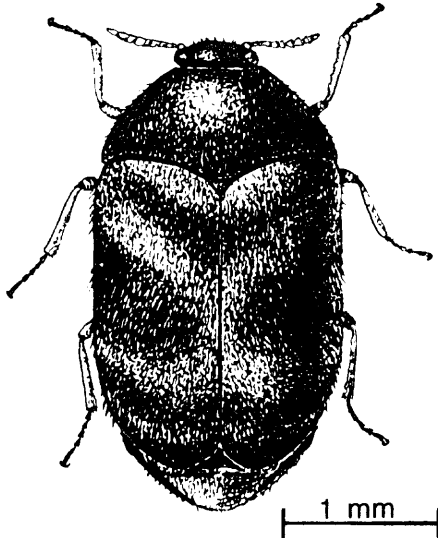


THE KHAPRA BEETLE, TROGODERMA GRANARIUM EVERTS

(COLEOPTERA:DERMESTIDAE)¹

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INTRODUCTION: The khapra beetle, Trogoderma granarium Everts, is one of the world's most feared stored-product pests. 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).

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.

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 New Jersey, Maryland, Michigan, and New York. The 1980 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 has been intercepted at ports of entry.

IDENTIFICATION: Adults are oblong-oval beetles, ca. 1.6-3.0 mm long by 0.9-1.7 mm wide (Fig. 1A). 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 11-segmented antennae. 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. Larvae at hatching are ca. 1.6-1.8 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 ca. 6 mm long and 1.5 mm wide (Fig. 1B). Larvae bear characteristic body hairs: (1) simple hairs in which the shaft bears many small, stiff, upwardly directed processes,

Fig. 1. Trogoderma granarium Everts. A) Adult. B) Larva. (Fig. 1A and 1B after Anonymous, 1962.)

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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 apparently do not fly and feed very little. Mated females live from 4-7 days, unmated females from 20-30 days, and males from 7-12 days. Mating occurs about 5 days after emergence, and egg laying begins almost immediately at 40°C. Egg laying may begin at 1-3 days at cooler temperatures, but no eggs are produced at 20°C. Eggs hatch in 3-14 days after the female lays an average of 50-90 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 CONTROL: 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 panelling 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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