INSECTS AND MITES IN STORED AGRICULTURAL PRODUCTS IN NEW ZEALAND

K. G. SOMERFIELD

*Plant Diagnostic Service, Department of Agriculture,
Christchurch*

Summary

The host materials and other details are described of beetles, moths, a fly, and mites which commonly infest stored agricultural products. Characteristics are given of primary and secondary pests of grain. The importance of hygiene and prevention of infestation before and during storage, in preference to control once pests have established, is emphasized.

INTRODUCTION

A LARGE NUMBER of insects have been recorded infesting and damaging stored agricultural products. Many that are present in New Zealand also occur throughout the rest of the world. Other species important overseas are not yet established in this country.

Many of the pests in New Zealand can do considerable damage to stored products and frequent reports are made of infested materials. The more important or commonly encountered species are described here.

Pests of stored seed and grain in New Zealand, and their control, are described by Morrison (1956) and French (1968). Belton (1950) lists insects infesting stored foods and produce in Dunedin. Wise (1955, 1956, 1961) gives detailed records of food materials for the Phycitidae (Lepidoptera) and the Ptinidae (Coleoptera). Some Lepidoptera are mentioned briefly by Manson (1965); Lowe (1968) gives information on the angoumois grain moth (*Sitotroga cerealella*). Food materials and life-history data of the cheese skipper (*Piophilidae casei*) are described by Miller (1929).

A review of the literature on stored products insects has been made by Parkin (1956). Munro (1966) gives an account of pests in Britain. Keys for the identification of common insect pests have been published by Hinton and Corbet (1963) and Hinton (1945) gives keys to a number of families of Coleoptera. Mallis (1960) gives information on life histories, food materials and methods of control.

PESTS OF STORED AGRICULTURAL PRODUCTS

Beetles (Coleoptera) and moths (Lepidoptera) are the insect groups which generally do most damage. Others (*e.g.*, cockroaches and silverfish) may occur, though they usually cause less economic loss. Mites (Acarina) infest many materials; they are of greatest significance in stored grain.

Some insects are capable of completing their life-cycle within the one food material. Those which feed on grain, and complete the immature stages of their life-cycle within the kernel, are termed *primary pests*—*e.g.*, grain weevil (*Sitophilus granarius*). Pests which usually feed on damaged grain and complete their life-cycle outside the kernel are termed *secondary*

pests—e.g., saw-toothed grain beetle (*Oryzaephilus surinamensis*), Indian meal-moth (*Plodia interpunctella*).

Insects damage a material by chewing, pitting, and boring into it. They alter its properties and lower its commercial value. The food value of edible goods is decreased and infested flour tends to agglutinate. Pests contaminate the food material with faeces and spread disease in this way and via feet and mouthparts.

Characteristics which generally enable insects to become major pests of stored products include: a short life-cycle; production of a large number of eggs; resistance to desiccation of all stages; small size and obscure colour; ability to survive temporary starvation; and tolerance of a range of temperatures.

Common names of pests often indicate a preferred host material, although these species are usually capable of infesting a range of products. In general, common names have been taken from *Standard Names for Common Insects* (Anon., 1967); these are indicated by an asterisk.

Information relating to pests (beetles, moths, flies and mites), which are treated in taxonomic order, is given in the following text; the importance of hygiene is described in a concluding section.

BEETLES (Coleoptera)

Both larvae and adults of many beetles feed on and damage stored products.

FAMILY: DERMESTIDAE (hide and bacon beetles). Length: 3-12 mm; bodies characteristically oval, convex and covered with fine hairs. Approximately 20 species occur; three commonly encountered are included.

Dermestes maculatus (hide beetle*). This is dark brown to black, with whitish areas on the sides of the prothorax; each wing-cover is produced to a small point at the rear apex. It damages fur, hides and skins.

Dermestes lardarius (larder beetle*) can infest and ruin stored bacon, hams and sausages, cheeses, leather, fur and meals of various kinds.

Dermestes ater feeds on a wide range of proteinaceous materials, especially those of animal origin.

Dermestes larvae also do damage.

FAMILY: ANOBIIDAE

Stegobium paniceum (drug store beetle*). Length: 2-3 mm; widely distributed and frequently abundant; preferred food is grain and flour but it feeds on meal, breakfast foods, spices and seeds.

Lasioderma serricorne (tobacco beetle*) is similar in size to *S. paniceum*. Primarily a pest of processed tobacco, it also attacks spices, seeds, rice and other dried vegetable products.

FAMILY: PTINIDAE (spider beetles*). Small size and relatively long legs characterize these insects.

Ptinus tectus (Australian spider beetle). Length: 2.5-4 mm; the most common species of the genus and widely distributed in New Zealand; other species of *Ptinus* have also been recorded infesting agricultural products. *P. tectus* damages many materials including seeds, deerskins, sheepskins, flour, milk powder, meals, bran and raw wool.

FAMILY: BOSTRICHIDAE

Rhizopertha dominica (lesser grain-borer*). Length: 2.5-3 mm. The body is cylindrical, with the head concealed from above. It is a primary pest of stored grain. Both larvae and adults destroy the starchy interior of grain and pieces of the seed coat. It is a major pest of grain in Australia and other warm countries.

FAMILY: OSTOMATIDAE

Tenebroides mauritanicus (the cadelle*). Length: 7-11 mm. This is a relatively large species. It feeds on flour, dried fruit and nuts, cereals and breakfast foods, maize, oats and potatoes.

FAMILY: CLERIDAE

Necrobia rufipes (red-legged ham beetle*). Length: 3.5-7 mm. The adult is shiny blue to green. It prefers dried meats, though large quantities are only occasionally injured. Copra stored in New Zealand is often attacked; other food materials are fish, bone meal and cheese.

FAMILY: CUCUJIDAE

Cryptolestes spp. Length: approximately 1.5 mm. These very small beetles are flattened, light brown, and possess long antennae. Grain, flour and dried fruit are food materials.

FAMILY: SILVANIDAE

Oryzaephilus spp. Length: 2.5-3.5 mm. These beetles are characterized by six prominent teeth on each side of the prothorax. Two species, *O. surinamensis* (saw-toothed grain beetle*), and *O. mercator* (merchant grain beetle), are very similar in general appearance. Both have been recorded from a variety of materials.

FAMILY: TENEBRIONIDAE

Tenebrio spp. (meal-worms*). Length: 14-18 mm. These relatively large insects infest grain, bran and cereal products but do not occur as often as smaller species.

Tribolium spp. (flour beetles*). Two closely-related species, which are widespread pests, are *T. castaneum* (rust-red flour beetle, Fig. 1a, b) and *T. confusum* (confused flour beetle*). They are elongate, shiny and reddish-brown; *T. castaneum* is 3-4 mm long, *T. confusum* is 4-4.5 mm. Both species occur in bulk wheat, though they cannot attack undamaged grain. When present in large numbers, they cause an increase in the water content of the host material; mould develops rapidly and flour turns grey. Secretions from their scent glands taint flour. Cereal products, peas, beans, nuts and dried fruit are infested.

Alphitobius diaperinus (lesser mealworm*). Length: 5.5-7 mm. This species has been recorded from mill flour and wheat (Belton, 1950).

FAMILY: BRUCHIDAE

Bruchid beetles are predominantly plant feeders; some species destroy leguminous seeds. *Acanthoscelides obtectus* (common bean weevil*) occurs in New Zealand.

FIG. 1 (a): Rust-red flour beetle (*Tribolium castaneum*), with main parts labelled. Insects typically have the body divided into head, thorax and abdomen. The head bears the antennae (or feelers) and the mouthparts (including the mandibles or jaws, which damage stored materials). The thorax bears three pairs of jointed legs and, in many insects, wings on the second and third thoracic segments. Wings are frequently modified; in beetles the fore-wings are hardened and thickened, forming covers (elytra; singular, elytron) for the flight wings (these are absent in some species). In beetles, only the first part of the thorax (the pronotum) is visible from above. (After Munro, 1966).

(b): Larva of rust-red flour beetle. Head (with associated appendages), thorax (with legs) and abdomen are present; in many insect larvae—e.g., maggots—the major divisions of the body and appendages are not readily apparent. (After Ross, 1956).

FIG. 2: Rice weevil (*Sitophilus oryzae*). The rostrum (snout) and angled antennae are characteristic of weevils. (After Manson, 1963).

FAMILY: CURCULIONIDAE (weevils).

Members of this family frequently attack growing crops throughout the world.

Sitophilus spp. Length: 3-4 mm.

Sitophilus oryzae (rice weevil*, Fig. 2), *Sitophilus granarius* (grain* or granary weevil) and *Sitophilus zeamais* (corn* or maize weevil) are primary pests of stored grain. The rice weevil has wings and four reddish spots on the dull brown wing covers; the grain weevil lacks wings. The maize weevil can only be accurately identified by studying the genitalia.

Produce attacked by the rice and grain weevils includes wheat, mill flour, barley, oats and rice. The maize weevil is a slightly larger species and predominantly attacks stored maize.

These weevils have similar life-cycles; the grain weevil can withstand lower temperatures than the others. The female lays eggs in small cavities chewed in grain. The larvae hatch, feed and grow in the grain and then pupate. The adults emerge and bore out of the grain, to continue the infestation process.

Many other beetles can infest stored agricultural products, including *Ahasverus advena* (foreign grain beetle), *Carpophilus* spp. (dried fruit beetles); and *Gnathocerus cornutus* (broad-horned flour beetle).

MOTHS (Lepidoptera)

Most damage by Lepidoptera to stored products is done during the larval stages. The larvae possess biting mouthparts and they feed on, grow in, and pollute grain and other materials. They also often produce extensive webbing which contaminates damaged and whole grain and seeds and may ruin it.

FAMILY: GELECHIIDAE

Sitotroga cerealella (Angoumois grain moth*). Wingspan: 15-18 mm (Fig. 3a, b). This small moth is coloured pale golden-yellow. It is a primary pest; the larva lives inside grain, making detection at an early stage difficult. Stored maize is the most commonly infested material in New Zealand. *Sitotroga cerealella* also infests wheat, sorghum and rice. It may be introduced to stored grain from heads infected in the field.

FAMILY: OECOPHORIDAE

Endrosis lactella (white-shouldered house-moth*). Wingspan: 13-15 mm. The head, thorax and front part of the fore-wings of this moth are characteristically coloured white. The larva feeds on stored seeds, broken grain and flour.

Hofmannophila pseudospretella (brown house-moth*). Wingspan: 15-22 mm. A brown moth, with darker flecks on the fore-wings; it prefers damp situations. Larval food includes cereal spillage, sacking, bulk wheat, seeds and bagged flour. Portions of food material are bound into the cocoon. The eggs and larvae can withstand prolonged unfavourable periods.

FAMILY: PHYCITIDAE

The moths listed in this family, although relatively common, can only be reliably identified by studying the genitalia.

Ephestia elutella (warehouse moth or tobacco moth*). Wingspan: approximately 16 mm. Light greyish-brown; the larva feeds and breeds in grain, peas, beans, cocoa, oatmeal, dried fruits, nuts and tobacco. The larvae migrate when full-grown and pupate in sheltered locations.

Anagasta kuehniella (Mediterranean flour moth). Wingspan: approximately 23 mm. This species is a pest of flour mills and granaries. Much more flour is spoiled than consumed and webbing produced by the larvae can block milling machinery. Other materials infested are wheat, seeds, nuts, dried fruit and cocoa. The adult is dull grey.

Cadra cautella (dried fruit* or currant moth). Wingspan: 14-20 mm. Dried fruit is preferred, but the insect often infests shelled nuts, grain and seeds. It is a grey moth, which originated in warmer countries.

FIG. 3 (a): Angoumois grain moth (*Sitotroga cerealella*). Moths have the wings, body and legs covered by minute scales. The wings are fringed with hairs.

(b): Larva of Angoumois grain moth. (Both after Mallis, 1960).

FIG. 4: Cheese skipper (*Piophilidae casei*). True flies have only one pair of membranous wings; the hind wings are modified to form balancing organs. The mouthparts are adapted for piercing or sucking; mandibles are absent in adults but present in many larvae. (After Mallis, 1960).

FIG. 5: Flour mite (*Acarus siro* complex), adult female. Mites have four pairs of legs when fully grown. The body has no obvious division into head, thorax and abdomen. Mites are usually 1 mm or less in length. (After Munro, 1966).

Plodia interpunctella (Indian meal-moth*). Wingspan: approximately 18 mm. The front parts of the forewings are pale coloured and the rear parts are reddish brown. Originally a pest of maize meal in the United States, it is now widely distributed and can feed on many materials, including dried fruits, nuts, macaroni, lentils and wheat bran.

FLIES (Diptera)

Flies can make products unfit for use by contaminating them with eggs, larvae and faeces. There is a risk of disease-causing organisms being transmitted to edible materials wherever flies exist.

Two overlapping categories occur. The most important group, the true storage pests, consists of relatively few species. These flies (e.g., the cheese skipper) can heavily contaminate a food material. The other larger group, the associated pests, includes flies such as the housefly* (*Musca domestica*) and blowflies* (*Calliphora* spp.). These may occur around various stored products and occasionally infest them but generally they are less harmful than true storage pests.

FAMILY: PIOPHILIDAE

Piophilidae casei (cheese* or ham skipper). Length: approximately 3 mm. The adult is a black fly, with a bronzy thorax and slightly iridescent wings (Fig. 4). The common names refer to the larvae. The cheese skipper is primarily a pest of cheese but it can be a pest of meat and sometimes other materials of commercial and medical importance. Infested cheese has slightly sunken areas, which are soft and waxy when opened; overseas, 52,000 skippers have been reared from one dry-cured ham.

MITES (Acarina)

Although very small individually, mites are important pests. A high reproductive capacity enables them to become abundant rapidly in favourable situations. High relative humidity also encourages their increase; grain with a moisture content above 13% to 15% is liable to infestation. A resistant nymphal stage, the hypopus, enables some mites (*e.g.*, *A. siro*) to survive adverse conditions.

FAMILY: TYROGLYPHIDAE

Acarus siro complex (meal mites* or flour mites). These are the most serious acarine pests of grain and flour; their bodies can also leave a taint making the latter inedible. Their colour is pearly white, with pinkish or brownish legs. Figure 5 shows an adult female.

Tyrophagus putrescentiae. This species (which has many synonyms) occurs on a wide variety of stored goods.

A number of other mites of the Tyroglyphidae are important pests.

Cheyletus eruditus is a widely-distributed predatory species which frequently occurs in grain containing Tyroglyphid mites.

IMPORTANCE OF HYGIENE

As the quantity of agricultural products stored in New Zealand is increased, the potential economic loss through insect and mite infestation also increases. Prevention of infestation is a basic requirement and is cheaper than eradication of pests which have become established.

Attention to hygiene is of major importance. All possible sources of infestation should be eliminated. Storage areas should be thoroughly cleaned and spillage disposed of; small residual quantities can harbour insects which may quickly infest new material. Old storage bags should be fumigated or destroyed. Trucks and other cartage machinery should be thoroughly cleaned down. After cleaning, the storage area should be sprayed with an approved residual-type insecticide; great care must be taken where materials to be stored are ultimately meant for human or animal consumption.

Biological control is generally ineffective against stored products pests. This places increased emphasis on cleanliness prior to and during storage.

ACKNOWLEDGEMENTS

L. G. Morrison, Officer-in-Charge and D. C. M. Manson, Entomologist, Levin Horticultural Research Laboratory, provided access to records and assisted in other ways; my wife, formerly technician, Levin Laboratory, gave technical assistance. A. D. Lowe and R. P. Macfarlane, Entomology Division, DSIR, Lincoln, provided helpful discussion. Acknowledgment is made to these people for their assistance.

REFERENCES

- Anon., 1967: *Standard Names for Common Insects*. Entomological Society of New Zealand (Inc.) 12 pp.
- Belton, C. H., 1950: *N.Z. Jl Sci. Tech.*, A 32: 44.
- French, R. A., 1968: *N.Z. Jl Agric.*, 117: 30.
- Hinton, H. E., 1945: *Beetles Associated with Stored Products*. Vol. I. Brit. Mus. Nat. Hist. 1st edn., 445 pp.
- Hinton, H. E.; Corbet, A. S., 1963: *Common Insect Pests of Stored Food*. Brit. Mus. Nat. Hist. Economic Series No. 15. 4th edn. HMSO, London. 61 pp.
- Lowe, A. D., 1968: *New Zealand Farm Pests in Colour*. Reed, Wellington. 54 pp.
- Mallis, A. H., 1960: *Handbook of Pest Control*. MacNair-Dorland Co., New York. 4th edn. 1148 pp.
- Manson, D. C. M., 1963: *Native Beetles*. Reed, Wellington. 64 pp.
- 1965: *Native and Introduced Butterflies and Moths*. Reed, Wellington. 63 pp.
- Miller, D., 1929: *N.Z. Jl Sci. Tech.*, 11: 52.
- Morrison, L. G., 1956: *N.Z. Jl Agric.*, 93: 316.
- Munro, J. W., 1966: *Pests of Stored Products*. Hutchinson, London. 234 pp.
- Parkin, E. A., 1956: *A. Rev. Ent.*, 1: 223.
- Ross, H. H., 1956: *A Textbook of Entomology*. Wiley, New York. 2nd edn. 519 pp.
- Wise, K. A. J., 1955: *N.Z. Jl Sci. Tech.*, B 36: 523.
- 1956: *N.Z. Jl Sci. Tech.*, B 37: 503.
- 1961: *N.Z. Jl Sci.*, 4: 836.