



IPM: Integrated Pest Management

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Insect Metamorphosis

There are several types of metamorphosis in the insect world, ranging from no apparent metamorphosis, with only a change in size and sexual maturity, to complete metamorphosis, with quite drastic changes in both appearance and feeding habits. Both the type of metamorphosis and the developmental stage of an insect should be considered when designing a pest management program.

Metamorphosis means "change in form". Most insects undergo this change, sometimes along with a change in habits and needs, to a greater or lesser degree, at some point in their lives. The change occurs during molting, when the exoskeleton becomes too small, splits, and is shed.

Simple Metamorphosis.

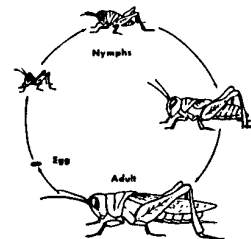
Insects with simple metamorphosis have three life stages: egg, nymph, and adult. These insects may have wings which, if present, develop externally. Young are known as nymphs and there is no resting stage. Insects with simple metamorphosis can be further broken down into those with no (or no apparent) metamorphosis, those with incomplete metamorphosis, and those with gradual metamorphosis.

■ **No Metamorphosis.** In the case of insects with no apparent metamorphosis (ametabolous insects), adults differ from nymphs only in size and in possession of fully developed reproductive organs. Included in this group are springtails (Order Collembola) and silverfish (Order Thysanura).

■ **Incomplete Metamorphosis.** Insects with incomplete metamorphosis (hemimetabolous insects),

include such insects as mayflies (Order Ephemeroptera), dragonflies and damselflies (Order Odonata), and stoneflies (Order Plecoptera). In these orders, the immatures or nymphs are known as **naiads**. Naiads are aquatic and possess gills for breathing. Nymphs and adults occupy different habitats and feed on different foods.

■ **Gradual Metamorphosis.** Insects with gradual metamorphosis (paurometabolous insects), include many orders with some of our worst pests. Nymphs and adults live in the same habitat and feed on the same foods. In the case of pest insects, both nymphs and adults will have the same pest status. Immature forms are known as **nymphs**. Included in this group are grasshoppers, crickets, cockroaches, walking-



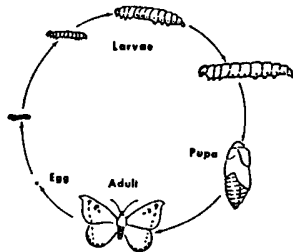
Gradual Metamorphosis

sticks, and mantids (Order Orthoptera), earwigs (Order Dermaptera), termites (Order Isoptera), booklice (Order Psocoptera), chewing and sucking lice (Orders Mallophaga and Anoplura), true bugs (Order Hemiptera), and cicadas, hoppers and aphids (Order Homoptera). Adults and nymphs of these insects usually feed on the same foods.

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Complete Metamorphosis.

In the case of insects with complete metamorphosis (holometabolous insects), the wings, if present, develop internally. The active immature stages are known generally as **larvae**. In some orders, larvae are referred to by other names, such as maggots (flies), caterpillars (butterflies and moths), or grubs (beetles). These insects also have a resting stage known as a pupa.



Complete Metamorphosis

Insects with complete metamorphosis include lacewings (Order Neuroptera), beetles (Order Coleoptera), caddisflies (Order Trichoptera), butterflies and moths (Order Lepidoptera), flies (Order Diptera), fleas (Order Siphonaptera), and sawflies, ants, wasps and bees (Order Hymenoptera).

Larvae and adults of insects with complete metamorphosis live in very different habitats and often feed on different types of food. The different life stages of a single pest species may therefore require vastly different management strategies. In many cases, only one stage may be a damaging pest. Larvae of insects with complete metamorphosis usually have chewing mouthparts; many are pests of various crops.

Intermediate Types of Metamorphosis.

A few insects exhibit intermediate types of metamorphosis, types that don't fit any of the above descriptions. Thrips and whiteflies fall into this intermediate group. Thrips pass through two nymphal stages, in which the nymphs feed on the same food as the adults. Next are prepupal and "pseudopupal" stages, before the insect molts to the adult stage. Whiteflies, even though considered to have gradual metamorphosis, pass through a pupal or resting stages before molting to the adult.

Pest Management Implications.

In the case of insects with complete metamorphosis, it is as if one species is represented by two or three completely different animals with different needs and habits. Control of insects with life stages having vastly dissimilar feeding habits require different management techniques. The larvae feed and live in one habitat and may leave that area to molt to the pupal stage. The adult may occupy an entirely different habitat and return to the larval feeding site only to lay eggs.

For example, house fly maggots often can be controlled through manure management, whereas the adult house fly is better managed through the use of exclusion devices or foggers. Similarly, the southern corn rootworm and its adult stage, the spotted cucumber beetle, require different scouting techniques and different management strategies. In the case of many insects with gradual metamorphosis, (e.g., the potato leafhopper) both nymphs and adults occupy the same habitat, feed on the same foods, and therefore generally require the same scouting and management techniques.