Public Heath Pesticide Applicator Training Manual

INTRODUCTION

This manual contains the information needed to become a certified commercial applicator in Category 8, Public Health Pest Management. It is intended for use in combination with the *Pesticide Applicator Core Training Manual* available in each state through the Pesticide Coordinator or the State Cooperative Extension Service.

The primary objective of the manual is to provide States with a relatively easy means of updating existing certification manuals. Materials herein may be used by States to replace or update existing manuals for certification of public health pesticide applicators. States are encouraged to excerpt relevant portions if the entire manual exceeds their specific needs, and adhere to the citation guidelines cited below.

To expedite this process, an electronic version will be distributed to the Pesticide Coordinator in each State. HTML and PDF files can be found on the Internet at http://www.ifas.ufl.edu/~pest/vector/ including tutorials on public health pests. In those States which have accepted this training tool, applicators may test their knowledge by using these tutorials. Formal examinations are held periodically in every State so that public health pesticide applicators can become certified or recertified by providing evidence of sufficient continued education.

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I. OBJECTIVES OF CERTIFICATION TRAINING

A wide variety of pests fall within the public health domain as a great many species of arthropod and vertebrate animals impact on the health and well being of residents in the United States. Some public health pest threats have similar origins throughout the country, whereas others are quite unique and require different approaches for their control. This document attempts to cover all applicable pest

categories found in the Unites States, which generally is broader coverage than currently found in most existing State manuals.

The coverage includes information on the biology and control of the pests as well as the diseases or disabilities that they cause. To clarify the recommendations included in the document, the behavior and habitats of specific vectors and pests and the modes of disease transmission are described and discussed in connection with current control concepts designed to reduce the impact of the pest and / or the related diseases.

Specific information is provided concerning accepted surveillance practices and routines commonly used to detect the presence of vector threats to public health. An extended discussion is included to provide applicators with the rules and regulations regarding not only safe use and handling of pesticides, but also methods to reduce the probability of human and environmental risk associated with misuse and accidental exposure to or escape of pesticides into the environment. This discussion is an expansion of what is normally found in the *Core Manual* and is included to heighten applicator awareness of proper pesticide handling practices. Additional relevant topics include toxicology, pesticide classification, worker safety, equipment and equipment calibration.

The text also deals with personal vs. community responsibility for mitigation of public health pest threats. One chapter dwells solely on the infrastructure and responsibility of control organizations and how they fit into the overall scheme for protection from the variety of public health pest threats encountered in the United States and those that might predictably be introduced through international commerce, individual travel or by mobile vectors and hosts.

Public health pests abound throughout the nation. In some States training of pesticide applicators includes more topics and more specific pests than in others. But the principles are similar throughout and use of this manual or excerpts will allow each State to continue to determine which pests and issues to include in its own certification manual without the need to conduct an in-depth upgrade of its existing documentation.

Broad comprehension of these topics is expected of pesticide applicators by the general public and governmental agencies. Within the guidelines specified by the United States Environmental Protection Agency (EPA), each State decides which aspects are key features for which specific knowledge is required. This perspective may be provided during the formal training sessions and in the practice questions provided at the State and local levels. By understanding the nature of these issues and the strengths and limitations of the tools available for resolving them, public health pesticide applicators can effectively conduct their tasks in a responsible manner.

II. SOURCES

This document contains excerpts from many published agency manuals. The authors gratefully acknowledge input in the form of printed and electronic materials, graphics, and review and constructive criticism received from the States, agencies and individuals listed below.

Materials

California - Bruce Eldridge, University of California, Davis

Florida - Thomas Loyless, Florida Department of Agriculture & Consumer Services

Georgia - Paul Guillebeau, Georgia Cooperative Extension Service

Hawaii - Charles Nagamine, Hawaii Department of Health

Louisiana - Lamar Meek, Louisiana State University

Michigan - Carolyn Randall, Michigan State University Extension

Missouri - Flernoy Jones, University of Missouri Cooperative Extension Service

Nebraska - Clyde Ogg, Nebraska Cooperative Extension Service

Nevada - Wayne Johnson, Nevada Cooperative Extension Service

New Jersey - Christine Musa, Warren County Mosquito Control

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North Carolina - Barry Engber, North Carolina Department of Environmental & Natural Resources

Ohio - Richard Berry, Ohio Department of Health

Oklahoma - Jm Criswell, Oklahoma Cooperative Extension Service

Texas - Jimmy Olson, Texas A & M University

Utah - Clark Burgess, Utah Department of Agriculture & Food

Washington - Carol Ramsay, Washington State University Cooperative Extension Service

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Department of Defense - Donald Driggers, Armed Forces Pest Management Board

Environmental Protection Agency - Robert Rose, Training and Certification Division

Peer Reviews

Gary Clark, Centers for Disease Control and Prevention

Alan Curtis, Indian River Mosquito Control, Vero Beach Florida

Nancy Hinkle, University of California, Riverside

Jerome Hogsette, Agricultural Research Service, USDA

Robert Novak, Illinois Natural History Survey, Champaign, Illinois
Jimmy Olson, Department of Entomology, Texas A&M University

Special thanks goes to Robert Rose, EPA Biologist, who envisioned the long term need for updated certification and training materials for pesticide applicators in the country and shared with the authors the desire to provide a common format to States with public health certification programs and easy access by the applicators who are responsible for ensuring the safe use of pesticides.

III. BIOLOGY REVIEW

Living things are divided into the plant kingdom, the animal kingdom, and several smaller kingdoms of microscopic life. Two phyla include the important major vectors and pests of public health significance.

Phylum Arthropoda

The animals in this, the largest group of the animal kingdom, are the invertebrates - the insects and their relatives. Arthropods include spiders, mites, ticks, millipedes, centipedes, crabs, shrimp, and insects, all of which characteristically have jointed legs and:

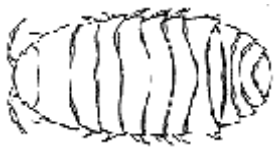
- A body made of segments, which are grouped or fused together;
- Legs, antennae, and other appendages attached in pairs; and
- A hard or tough external covering, the **exoskeleton**, with some pliable, or soft parts.

The exoskeleton holds the body together and gives it shape, performing the same function as the mammal's bony internal skeleton.

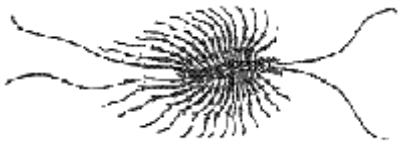
Principal **classes** of arthropods are:

Arachnida. This class includes spiders, mites, scorpions, ticks, daddy longlegs and others. These arthropods usually have mouthparts with two prominent structures that end in needle-like piercing tips. They have four pairs of legs and two body regions. The mouthparts and legs are attached to the first region and the reproductive organs and digestive system are contained in the second region.

Crustacea. This class includes aquatic crabs, lobsters, and shrimp, as well as crustaceans that dwell on land (pillbugs and sowbugs).



Myriapoda. This group is made of two classes - millipedes and centipedes. The millipedes are many-segmented and worm-like; they are cylindrical with short antennae and two pairs of legs per segment. Centipedes are also many-segmented and worm-like, but they appear more flattened and have one pair of legs per segment, antennae and long hind legs (all legs of the house centipede are very long).



Insecta. This class contains the insects, which have three body regions - head, thorax, and abdomen. The head bears a single pair of antennae. The thorax bears three pairs of legs and usually one or two pairs of wings. The abdomen contains most of the digestive system and the reproductive organs.

The class Insecta is divided into **orders**, which are distinct groups whose members look very much alike, for example, the Lepidoptera (moths and butterflies), Coleoptera (beetles) or Diptera (flies and mosquitoes). Orders are subdivided into **families**, which in turn are comprised of several **genera** (the plural form of **genus)**. The genera include closely related **species**. Species of animals can be thought of as specific kinds of animals. Species are given scientific names that always consist of two words. The first identifies the genus name (first letter always capitalized) and the second is the species name (always lower case). Both names are written in italics or underlined, as in *Musca domestica*. Sometimes the name of initial of the person who described the species is also included as in *Musca domestica* L. (L. for Linnaeus, the describer). Well known species also may have non-scientific names called "common names", as for the house fly in this example.

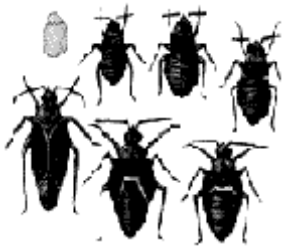
Structural characteristics of the mouthparts vary dramatically among insects. In addition to the filter feeding mechanisms found in some aquatic forms, there are four basic types of insect mouthparts: chewing, sponging, piercing-sucking, and siphoning. Adult mosquitoes, for example, have piercing-sucking mouthparts, whereas mosquito larvae swallow everything that is small enough to pass through their filtering feeding mouthparts. Among the blood feeding species the females are universally blood feeders, but the males may or may not feed on blood, depending on the genus.

Most insect reproduction is sexual, that is, an egg cell from the female develops only after fertilization by a sperm cell from the male of the same species. However, some insect species are asexual and do not require a sperm cell.

Growth and development. The exoskeleton of the arthropod body can expand only a little, at the pliable or soft places. It does not grow continuously, but in stages. A new, soft exoskeleton is formed under the old one, then the old one is shed (**molted**). The new exoskeleton then expands while it is still soft so that it becomes larger than the old one and allows the animal to grow. It hardens and darkens in a few hours. After the molting process, the arthropod resumes its normal activities.

Most arthropods hatch as tiny individuals and increase in size through this molting process, usually keeping the same appearance until they become adults. However, a spectacular and very important exception occurs in insects. The class Insecta is divided into groups according to the way the insects change during their development. This technical term for this change is **metamorphosis**, which means "change in form." Three main types of metamorphosis are:

Simple Metamorphosis. This group, which includes silverfish, makes no drastic change in form from juvenile to adult. They simply hatch and grow larger by molting periodically. Only a few insect Orders are included in this group.



Gradual Metamorphosis. This group includes cockroaches, crickets, grasshoppers, boxelder bugs, earwigs, etc., which hatch from the egg as **nymphs** that partially resemble the adult form except that they do not have wings. Fourteen of the 26 Orders of insects develop in this way. Some of these Orders have many species and include many pests. Nymphs and adults are often found together and usually eat the same food.

Complete Metamorphosis. Insects that develop by complete metamorphosis undergo a complete change in appearance from juvenile to adult. The nine Orders with complete metamorphosis include the majority of insect species. In fact, they number more than all of the other species in the entire animal kingdom! This major group includes mosquitoes, flies, fleas, beetles, moths and butterflies, and stinging insects (ants, bees and wasps).

Insects with complete metamorphosis hatch from eggs as **larvae** (grubs, maggots and caterpillars). The larval stage feeds and grows and continues its development without changing form through a number of molts until it becomes mature. It then changes into a **pupa** which is often immobile. During the pupal stage, change and body rearrangement occurs, for example, development of wings and legs, resulting in transformation into the **adult** stage. Reproduction occurs during the adult stage.

The developmental stages of insects with complete metamorphosis support rather than compete with each other. It is as if two or three completely different animals with different needs and habits represent a single species. The larva feeds and lives in one habitat and sometimes leaves that area to pupate a short distance away. The adult emerges, requires adifferent food source and lives in another area, perhaps returning to the larval feeding sites only to lay eggs. For this reason pest controllers must manage species with complete metamorphosis differently according to where the different developmental stages lives and how they behave. The reader will need to pay special attention to sections that discuss the growth cycle, behavior, and harborage (the area in which the animal lives and finds its food) of each invertebrate.

Phylum Chordata

The vertebrates are represented by many dominant chordate species in the animal kingdom. The characteristic that sets them apart from the invertebrates is the presence of a spinal column that is usually surrounded by a backbone or vertebral column. This structure, the **skeleton,** allows "chordates" to grow continually because the skeleton is internal.

Individual vertebrates **classes** include amphibia, birds, fish, reptiles and mammals. As with the invertebrates, vertebrate species of interest to public health and pesticide considerations are found in a variety of orders, families, and genera. In this manual, there are sections dealing with bats, birds, snakes, rodents and other mammals that serve either as reservoirs of human pathogens or present other public health concerns.