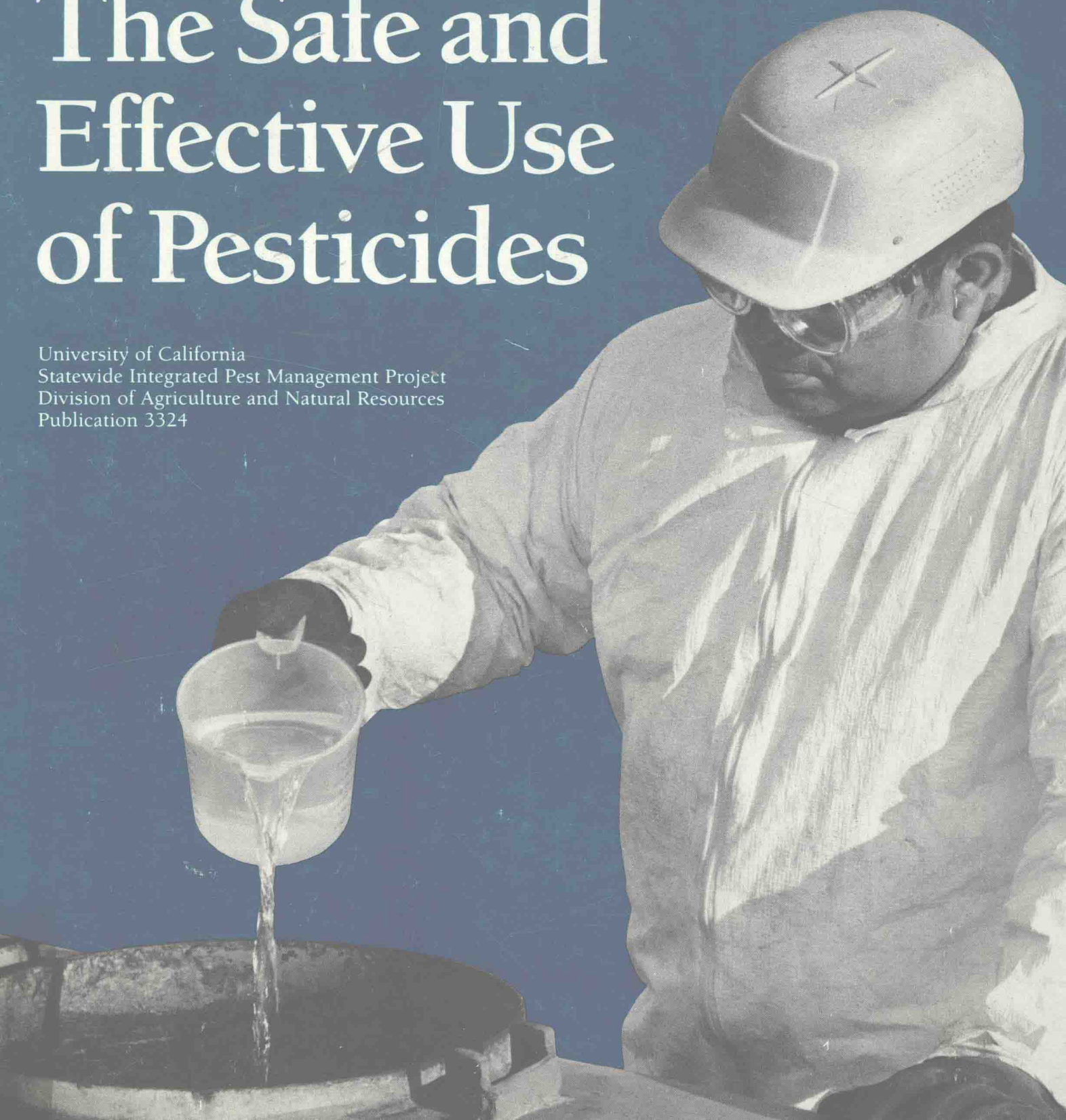


The Safe and Effective Use of Pesticides

University of California
Statewide Integrated Pest Management Project
Division of Agriculture and Natural Resources
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THE SAFE AND EFFECTIVE USE OF PESTICIDES

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Contents

Chapter 1: Introduction	1
Chapter 2: Pest Identification	7
How Plants and Animals Are Named	8
Ways to Identify a Pest	9
Weeds	12
Invertebrates	30
Nematodes	45
Snails and Slugs	48
Vertebrates	49
Disease Agents	51
Chapter 3: Pest Management	59
Approaches to Pest Management	60
Setting Up a Pest Management Program	61
Chapter 4: Pesticides	73
Pesticide Toxicity	74
How Pesticides Are Classified	80
Mode of Action	90
Formulations of Pesticides	96
Pesticide Mixtures	107
Adjuvants	113
Organic Pest Control Materials	120
Chapter 5: Pesticide Laws and Regulations	127
Enforcement	128
Pesticide Registration and Labeling	132
Deviations from Label Directions	137
Emergency Exemptions and Special Local Needs	140
Restricted-Use Pesticides	140
Chapter 6: Hazards Associated with Pesticide Use	149
Human Injury	150
Other Effects on People	157
Groundwater Contamination	158
Impact on Nontarget Organisms	164
Pesticide Resistance	168

Residues	170
Damage to Treated Surfaces	173
Chapter 7: Protecting People and the Environment	175
Pesticide Applicator Safety	176
Personal Safety Equipment	182
Field-Worker Safety	207
Public and Environmental Safety	211
The Safe Handling of Pesticides	211
Mixing Pesticides	216
Applying Pesticides Effectively	222
Clean-Up and Disposal	229
Record Keeping	230
Liability	232
Chapter 8: Pesticide Emergencies	235
First Aid	236
Pesticide Leaks and Spills	241
Pesticide Fires	243
Pesticide Thefts	244
Misapplication of Pesticides	244
Chapter 9: Effective Use of Pesticides	247
Pest Detection and Monitoring	248
Making Pesticide Use Decisions	256
Selecting the Right Pesticide	256
Selective Pesticides	261
The Selective Use of Pesticides	261
Follow-Up	269
Chapter 10: Pesticide Application Equipment	273
Liquid Application Devices	275
Dry Application Equipment	311
Livestock and Poultry Application Equipment	315
Bait Application Equipment	316
Sprayer Equipment Maintenance	317
Chapter 11: Calibration of Pesticide Application Equipment	323
Why Calibration Is Essential	324
Methods of Equipment Calibration	326
Calculations for Active Ingredient, Percent Solution, and Parts-Per-Million Solutions	350
Use of Personal Computers in Calibration	356
References	357
Glossary	369
Index	383

1 Introduction



Pesticide application is a highly skilled occupation requiring specialized training.

Applying pesticides requires many special skills and responsibilities. It is an important occupation on its own and an indispensable part of many other occupations. As a person who applies pesticides or supervises pesticide applicators, you must be sure pesticides are handled properly and safely. It is often necessary to identify pests and then select the best methods for their control. For your own safety, as well as that of co-workers and family, it is essential to understand the hazards of pesticides and how to avoid injury. Protecting the environment is also a major concern. Additionally, you need to be familiar with all state and federal laws regulating the use, storage, transportation, application, and disposal of pesticides.

This book is Volume I of the *Pesticide Application Compendium*. It is designed to help you learn safe and effective ways of using pesticides and to show you how to reduce accidents to avoid injury and environmental problems. Should problems occur, this book describes how to handle them. Volume I also includes general information on pesticides, chemical pest control, and other pest management methods. Use it as a study guide if you are preparing for the State of California Qualified Pesticide Applicator License (QL) or Qualified Pesticide Applicator Certificate (QC) examinations. The California Department of Food and Agriculture (CDFA) gives these tests to pest control operators and their authorized agents, commercial applicators, landscape maintenance personnel, researchers, pesticide dealers and their designated agents, and anyone else applying pesticides as part of their work. The *Pesticide Application Compendium* is also a useful reference for growers, structural pest control operators, pest control advisers, pest management students, homeowners, or anyone involved in pesticide use decisions. Finally, this book is a helpful instructional guide for training people in the use of pesticides.

Other volumes of the *Pesticide Application Compendium* cover the 11 occupational areas in which pesticides are used (Table 1-1). Applicants for a Qualified Applicator Certificate or Qualified Applicator License are required to take an examination in one or more of these specialized areas. If you plan to take some of these exams, thoroughly study the sections that are appropriate to your work, without neglecting areas in which you do not plan to be tested. Areas of pesticide use often overlap and knowledge gained in one section will help to understand the concepts in another.

There are many excellent books and publications dealing with pesticide use, how pesticides work, effects of pesticides on the environment, and other related topics. Some of these are listed in the References section at the end of this volume; use this as a reading list for additional information on the topics presented in each chapter. The Glossary includes definitions of technical terms and expressions that are used in pesticide application. An Index is also included to help locate information quickly.

In addition to this text and the references cited here, there are two important sources you should rely on for information regarding pesticides:

County agricultural commissioners are regulatory officials of the California Department of Food and Agriculture (CDFA). Their offices throughout the state have the responsibility, among other functions, for issuing permits for restricted pesticides, monitoring pesticide use, storage, and disposal, and enforcing pesticide worker safety regulations. Agricultural commissioners' offices provide local information on pesticide use, storage, transportation, disposal, and hazards. They should be contacted in the event of any pesticide emergency.

The University of California, through its Cooperative Extension Program, maintains offices in most counties of the state. Cooperative Extension offices are staffed by specialists who provide pest identification, pest management, and pesticide use information for home, structural, agricultural, livestock and poultry, rangeland, wildlife, turf and landscape, forest, and aquatic areas. Farm advisors work closely with other University of California researchers and specialists.

TABLE 1-1

Specialized Areas of Pesticide Application

SPECIALIZED AREA	DESCRIPTION OF PESTICIDE APPLICATOR'S WORK	TYPE OF PESTS
<i>Residential, Industrial, and Institutional Pest Control</i>	Performs pest control in apartments, restaurants, hospitals, offices, warehouses, grocery stores, and other similar buildings as part of employment by owner or operator of the building. Selects pest control methods and pesticides to use. Performs postharvest fumigation and insecticide and fungicide applications to agricultural products. Applies pesticides to stored agricultural products. Controls weeds around commercial and industrial structures. Work is often closely associated with people and their pets. A special subsection of this category, which requires a separate examination, relates to the application of pesticides for preservation of wood products such as lumber, posts, and other structural wood.	<i>Invertebrates:</i> cockroaches, bugs, stored product pests, flies, fleas, mosquitoes, termites, ants, other insects; spiders and mites. <i>Vertebrates:</i> rats, mice, bats, and birds. <i>Weeds:</i> <i>Microorganisms:</i> wood-decaying fungi.
<i>Landscape Maintenance Pest Control</i>	Controls pests on or around ornamental and fruit trees, shrubs, small fruits and berries, turf, and flowers; works around homes, businesses, cemeteries, theme parks, public parks, indoor malls, and house plants. Pesticide application is often part of a landscape maintenance business. Applicator makes decisions regarding pest control methods, irrigation, and plant nutrition. Work is closely associated with human activities.	<i>Invertebrates:</i> aphids, scales, flies, bees, wasps, earwigs, moths, beetles, and bugs; spiders, mites, and centipedes. <i>Vertebrates:</i> rats, mice, gophers, moles, squirrels, rabbits, birds, snakes, lizards. <i>Microorganisms:</i> fungi, bacteria, viruses. <i>Weeds:</i> various types of terrestrial weeds.

SPECIALIZED AREA	DESCRIPTION OF PESTICIDE APPLICATOR'S WORK	TYPE OF PESTS
<i>Right-of-Way Pest Control</i>	Performs pesticide applications along roads, rail lines, utility accesses, and drainage ditches to keep these areas free of undesirable weeds, to prevent fire hazards and obstruction of access or view. Applies pesticides for control of vertebrates and insects that interfere with desirable foliage or water drainage. A special subsection of this category, which requires a separate examination, relates to the application of pesticides for the preservation of wood products and utility poles.	<i>Weeds:</i> various types of terrestrial weeds. <i>Vertebrates:</i> Squirrels, mice, gophers, moles, rabbits, birds. <i>Invertebrates:</i> pests of foliage and wood products.
<i>Forest Pest Control</i>	Applies pesticides in forest locations. Is responsible for protecting wildlife, watershed, and lakes and streams.	<i>Invertebrates:</i> boring and defoliating insects of forest trees; mites. <i>Weeds:</i> mostly undesirable plant species competing with forest trees, parasitic plants. <i>Microorganisms:</i> plant disease agents affecting forest trees. <i>Vertebrates:</i> squirrels, voles, gophers, and others.
<i>Aquatic Pest Control</i>	Applies pesticides for control of aquatic weeds, pest fish, arthropods, and molluscs. Requires special skills to protect aquatic environments and nontarget organisms. Familiarity with aquatic ecosystems and the ultimate use of water is very important to protect people and crops.	<i>Aquatic weeds.</i> <i>Pest Fish.</i> <i>Invertebrates.</i>
<i>Plant Agriculture Pest Control</i>	Applies pesticides in and around agricultural crops. Often employed by a commercial applicator. Usually supervises equipment operators. Responsible for protecting field-workers, groundwater, and environment. May work with highly toxic materials.	<i>Invertebrates:</i> many different agricultural pest insects and mites, snails, nematodes. <i>Vertebrates:</i> squirrels, gophers, rabbits, birds. <i>Weeds:</i> many types of agricultural weeds and poisonous plants. <i>Microorganisms:</i> fungi, bacteria, and viruses that cause crop diseases.

SPECIALIZED AREA	DESCRIPTION OF PESTICIDE APPLICATOR'S WORK	TYPE OF PESTS
<i>Animal Agriculture Pest Control</i>	Applies pesticides for control of livestock and poultry pests. Requires familiarity with livestock and poultry and unique pest control techniques. Pesticide use is closely associated with animals.	<i>Invertebrates:</i> mosquitoes, lice, flies, and bugs; ticks and mites. <i>Vertebrates:</i> livestock and poultry predators. <i>Weeds:</i> poisonous plants and undesirable range weeds.
<i>Seed Treatment</i>	Performs or supervises the application of insecticides and fungicides to seeds used to produce agricultural crops. Requires familiarity with different methods of protecting seeds. Usually employed by a seed treatment company.	<i>Invertebrates:</i> seed feeding or damaging insects. <i>Microorganisms:</i> fungi and bacteria.
<i>Regulatory Pest Control</i>	Involved in the detection and eradication of imported pests that pose threats of economic harm to agriculture, livestock and poultry, or other segments of society. Must be familiar with suppression and eradication methods. Requires understanding of ways pests enter and disperse through an area. Usually works for a public agency.	<i>Invertebrates:</i> exotic insects and mites that threaten to cause economic or health damage. Nematodes and snails — damaging species that might be introduced from other areas. <i>Weeds:</i> aquatic, terrestrial, and exotic weeds. <i>Vertebrates:</i> reptiles, birds, and rodents and other mammals. <i>Microorganisms:</i> exotic plant disease organisms.
<i>Demonstration and Research Pest Control</i>	Evaluates pesticides for efficacy. Studies interactions between pests, nonpests, and environmental factors when pesticides are applied. Demonstrates proper and effective methods of using pesticides. May be pesticide chemical company field representative, farm advisor, university researcher, independent consultant, or contract researcher.	All types of agricultural and nonagricultural pests may be involved.
<i>Public Health Pest Control</i>	Involved in applying pesticides to control pests that transmit disease organisms to people. Usually employed by public agencies. Pesticide use is often closely associated with homes and workplaces.	<i>Invertebrates:</i> flies, fleas, cockroaches, mosquitoes, lice, bugs; ticks, mites, and spiders. <i>Vertebrates:</i> rats, mice, bats, birds,

How Plants and Animals Are Named	8
Scientific Names	8
Common Names	9
Ways to Identify a Pest	9
Identification Experts	10
Identification Keys	10
Photographs and Drawings	10
Preserved Specimens	11
Characteristic Signs	12
Weeds	12
How Weeds Are Pests	14
Identifying Weeds	15
Invertebrates	30
Arthropods	31
Nematodes	45
Snails and Slugs	48
Vertebrates	49
Disease Agents	51
Important Characteristics	51
Identifying Disease-Causing Pathogens	51
Bacteria	54
Fungi	55
Viruses	55
Viroids	56
Mycoplasmas	57

2

Pest Identification



Close examination may be necessary to identify pests which are causing damage.

Pests are organisms that compete with people for food or fiber, interfere with raising crops or livestock and poultry, damage property and personal belongings, disfigure ornamental plantings, transmit or cause plant or animal diseases, or are otherwise bothersome. Before trying to control a pest, it must be properly identified. Be certain that any injury or observed damage is actually due to the identified pest and not some other cause. Once you have identified the pest and confirmed that it is causing damage, become familiar with its life cycle, growth, and reproductive habits. Use this information to form your pest control plans. Misidentification and lack of information about a pest lead to use of improper control methods or incorrect control timing and are among the most frequent causes of pest control failure.

Four main groups of pests include: (1) weeds (undesired plants); (2) invertebrates (insects and their relatives, nematodes, snails, and slugs); (3) vertebrates (birds, reptiles, amphibians, fish, rodents, and other mammals); and (4) disease agents (bacteria, viruses, fungi, mycoplasmas, other microorganisms, and nonliving factors). This chapter reviews some of the fundamentals used to identify pests, including how to use identification aids.

HOW PLANTS AND ANIMALS ARE NAMED

Scientific Names

Classification systems are sets of rules used for organizing and naming living things. An elegant, standardized classification system used throughout the world is the basis for the scientific names given to plants and animals. This system reveals how different plants and animals are related. Scientific names are very useful when trying to locate information about an organism.

Living organisms are usually included in one of two major groups: the *Plant Kingdom* or the *Animal Kingdom*. Usually it is easy to distinguish between living organisms and nonliving objects and between plants and animals; however, microorganisms and algae are more difficult to classify because they may have characteristics that make them intermediate between plants and animals.

There are six subcategories within a kingdom in the typical classification system: *Phylum*, *Class*, *Order*, *Family*, *Genus*, and *Species*. Organisms are separated according to unique characteristics that set them apart from other organisms. For example, in the phylum Arthropoda all organisms have jointed appendages and an external skeleton, while animals in the phylum Chordata have a backbone, a spinal nerve cord, and an internal skeleton. Within a phylum there are several orders, each containing one or more families. A family is a group of related genera, and a genus is a collection of species. A species is unique from all other organisms, al-