## CONTENTS

### INTRODUCTION

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Introduction</td>
<td>xiii</td>
</tr>
</tbody>
</table>

### CHAPTER 1 PEST MANAGEMENT

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pest Problems throughout History</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Pest Control Over the Years</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>Pest Recognition</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Ways to Identify Pests</td>
<td>4</td>
</tr>
<tr>
<td>1</td>
<td>Characteristic Damage</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Pest Management Methods</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Biological Control</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>Chemical Control</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>Cultural Control</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>Genetic Control</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>Mechanical/Physical Control</td>
<td>8</td>
</tr>
<tr>
<td>1</td>
<td>Regulatory Control</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>Integrated Pest Management (IPM)</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>Why Practice IPM?</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>Components of IPM</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>Pest Population Thresholds</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>Prevention</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>Suppression</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>Eradication</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>Effectiveness of Pest Management Programs</td>
<td>13</td>
</tr>
<tr>
<td>1</td>
<td>Why Pesticide Applications Fail</td>
<td>13</td>
</tr>
<tr>
<td>1</td>
<td>Pesticide Resistance</td>
<td>13</td>
</tr>
</tbody>
</table>

### CHAPTER 2 FEDERAL PESTICIDE LAWS AND REGULATIONS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>The Need for Regulation</td>
<td>19</td>
</tr>
<tr>
<td>2</td>
<td>Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Pesticide Registration</td>
<td>21</td>
</tr>
<tr>
<td>2</td>
<td>Tolerances</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>Pesticide Reregistration</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>Registration and Tolerance Reassessment</td>
<td>23</td>
</tr>
</tbody>
</table>
Issues of Pesticide Regulation

Types of Pesticide Registration

Certification of Pesticide Applicators Regulation

Federal Pesticide Regulations under FIFRA

Trade, Brand, or Product Name

Parts of the Label

Use Classification Statement

Type of Pesticide

Net Contents

Name and Address of Manufacturer

Emergency Telephone Number

Registration Numbers

Establishment Number

Signal Words and Symbols

Precautionary Statements

Routes of Entry Statements

Specific Action Statements

Protective Clothing and Equipment Statements

Other Precautionary Statements

First Aid Statements

Environmental Hazards

Special Toxicity Statements

General Environmental Statements

Physical or Chemical Hazards

Agricultural Use Requirements

Restricted-Entry Intervals

Nonagricultural Use Requirements

Federal Recordkeeping Requirements

Chapter 3: Pesticide Labeling

EPA Approval of Pesticide Labeling

The Label

Background of the Label

Toxicity and Toxicological Tests

Efficacy or Performance Tests

Degradation, Mobility, and Residue Tests

Effects on Wildlife and the Environment

Types of Pesticide Registration

When to Read the Pesticide Label

Parts of the Label

Trade, Brand, or Product Name

Ingredient Statement

Use Classification Statement

Type of Pesticide

Net Contents

Name and Address of Manufacturer

Emergency Telephone Number

Registration Numbers

Establishment Number

Signal Words and Symbols

Precautionary Statements

Routes of Entry Statements

Specific Action Statements

Protective Clothing and Equipment Statements

Other Precautionary Statements

First Aid Statements

Environmental Hazards

Special Toxicity Statements

General Environmental Statements

Physical or Chemical Hazards

Agricultural Use Requirements

Restricted-Entry Intervals

Nonagricultural Use Requirements

Summary

Review Questions

Chapter 4: Pesticide Recordkeeping

Training Records

Application Records

Federal Recordkeeping Requirements

Other (40 CFR Part 171)

Worker Protection Standard Regulation (40 CFR Part 170)

Pesticide Container and Containment Regulation (40 CFR Part 165)

Other Federal Laws

Federal Food, Drug, and Cosmetic Act

Food Quality Protection Act

Endangered Species Act

Federal Laws

Federal Food, Drug, and Cosmetic Act

Food Quality Protection Act

Endangered Species Act

Other (40 CFR Part 171)

Worker Protection Standard Regulation (40 CFR Part 170)

Pesticide Container and Containment Regulation (40 CFR Part 165)

Violations and Federal Penalties

Penalties

Federal Pesticide Regulations under FIFRA

EPA Approval of Pesticide Labeling

The Label

Background of the Label

Toxicity and Toxicological Tests

Efficacy or Performance Tests

Degradation, Mobility, and Residue Tests

Effects on Wildlife and the Environment

Types of Pesticide Registration

When to Read the Pesticide Label

Parts of the Label

Trade, Brand, or Product Name

Ingredient Statement

Use Classification Statement

Type of Pesticide

Net Contents

Name and Address of Manufacturer

Emergency Telephone Number

Registration Numbers

Establishment Number

Signal Words and Symbols

Precautionary Statements

Routes of Entry Statements

Specific Action Statements

Protective Clothing and Equipment Statements

Other Precautionary Statements

First Aid Statements

Environmental Hazards

Special Toxicity Statements

General Environmental Statements

Physical or Chemical Hazards

Agricultural Use Requirements

Restricted-Entry Intervals

Nonagricultural Use Requirements

Summary

Review Questions

CHAPTER 3 PESTICIDE LABELING

EPA Approval of Pesticide Labeling

The Label

Background of the Label

Toxicity and Toxicological Tests

Efficacy or Performance Tests

Degradation, Mobility, and Residue Tests

Effects on Wildlife and the Environment

Types of Pesticide Registration

When to Read the Pesticide Label

Parts of the Label

Trade, Brand, or Product Name

Ingredient Statement

Use Classification Statement

Type of Pesticide

Net Contents

Name and Address of Manufacturer

Emergency Telephone Number

Registration Numbers

Establishment Number

Signal Words and Symbols

Precautionary Statements

Routes of Entry Statements

Specific Action Statements

Protective Clothing and Equipment Statements

Other Precautionary Statements

First Aid Statements

Environmental Hazards

Special Toxicity Statements

General Environmental Statements

Physical or Chemical Hazards

Agricultural Use Requirements

Restricted-Entry Intervals

Nonagricultural Use Requirements

Summary

Review Questions

CHAPTER 3 PESTICIDE LABELING

EPA Approval of Pesticide Labeling

The Label

Background of the Label

Toxicity and Toxicological Tests

Efficacy or Performance Tests

Degradation, Mobility, and Residue Tests

Effects on Wildlife and the Environment

Types of Pesticide Registration

When to Read the Pesticide Label

Parts of the Label

Trade, Brand, or Product Name

Ingredient Statement

Use Classification Statement

Type of Pesticide

Net Contents

Name and Address of Manufacturer

Emergency Telephone Number

Registration Numbers

Establishment Number

Signal Words and Symbols

Precautionary Statements

Routes of Entry Statements

Specific Action Statements

Protective Clothing and Equipment Statements

Other Precautionary Statements

First Aid Statements

Environmental Hazards

Special Toxicity Statements

General Environmental Statements

Physical or Chemical Hazards

Agricultural Use Requirements

Restricted-Entry Intervals

Nonagricultural Use Requirements

Summary

Review Questions

CHAPTER 3 PESTICIDE LABELING

EPA Approval of Pesticide Labeling

The Label

Background of the Label

Toxicity and Toxicological Tests

Efficacy or Performance Tests

Degradation, Mobility, and Residue Tests

Effects on Wildlife and the Environment

Types of Pesticide Registration

When to Read the Pesticide Label

Parts of the Label

Trade, Brand, or Product Name

Ingredient Statement

Use Classification Statement

Type of Pesticide

Net Contents

Name and Address of Manufacturer

Emergency Telephone Number

Registration Numbers

Establishment Number

Signal Words and Symbols

Precautionary Statements

Routes of Entry Statements

Specific Action Statements

Protective Clothing and Equipment Statements

Other Precautionary Statements

First Aid Statements

Environmental Hazards

Special Toxicity Statements

General Environmental Statements

Physical or Chemical Hazards

Agricultural Use Requirements

Restricted-Entry Intervals

Nonagricultural Use Requirements

Summary

Review Questions
## PESTICIDE FORMULATIONS

### Formulations: An Overview

- **Liquid Formulations**: 52
  - Emulsifiable Concentrates (EC or E) 52
  - Solutions (S) 53
    - Ready-to-Use (RTU) Low-Concentrate Solutions
    - Concentrate Solutions (C, LC, or WSC/WSL)
    - Liquid Baits
- Ultra-Low Volume (ULV) 54
- Invert Emulsions 55
- Flowables (F or AF) 55
- Aerosols (A) 55
  - Ready-to-Use Aerosols
  - Formulations for Smoke or Fog Generators

- **Dry or Solid Formulations**: 56
  - Dusts (D) 56
  - Granules (G) 57
  - Pellets (P or PS) 58
  - Wettable Powders (WP or W) 58
  - Water-Dispersible Granules (WDG) or Dry Flowables (DF) 59
  - Soluble Powders (SP or WSP) 59
  - Baits (B) 60
  - Pastels, Gels, and Other Injectable Baits

- **Other Formulations**: 61
  - Fumigants 61
  - Microencapsulated Pesticides (M) 61
  - Water-Soluble Packaging (WSB or WSP) 62
  - Impregnates 62
  - Animal Systemics 62
  - Pesticide-Fertilizer Combinations 62

- **Pesticide Mixtures**: 63
- **Adjuvants**: 63
  - Types of Adjuvants 64
  - Surfactants 64
  - Choosing the Right Adjuvant 65

- **Summary**: 66
- **Review Questions**: 67
CHAPTER 7 PESTICIDES IN THE ENVIRONMENT

The Environment .................................................. 105
Pesticide Characteristics ........................................ 106
Solubility ............................................................. 106
Adsorption .......................................................... 106
Persistence ......................................................... 106
Pesticide Breakdown
Vaporsity ........................................................... 107
How Pesticides Move in the Environment ..................... 107
Movement in Air ..................................................... 107
Movement in Water ............................................... 107
Movement on or in Objects, Plants, or Animals .......... 108
Preventing Pesticide Drift .......................................... 108
Spray Drift .......................................................... 108
Classification of Droplet Size
Other Factors
Temperature Inversions
Vapor Drift .......................................................... 111
Particle Drift (Dust Drift) .......................................... 111
Applicator Responsibility ....................................... 111
Sources of Water Contamination ................................ 112
Pesticide Contamination of Surface Water ................. 112
Pesticide Contamination of Groundwater ................... 113
Leaching
Soil Properties
Texture and Structure
Organic Matter
Depth to Groundwater
Geology
Preventing Surface Water and Groundwater Contamination .......................... 115
Use Integrated Pest Management Principles ................. 115
Identify Vulnerable Areas ....................................... 115
Do Not Mix and Load Near Water ............................. 115
Keep Pesticides Away from Wells ............................ 115
Avoid Back-Siphoning ......................................... 116
Improve Land Use and Application Methods ............... 116
Time Pesticide Applications According to the Weather Forecast ........................ 116
Select Products Wisely .......................................... 116
Handle Pesticides Safely ........................................ 116
### Preventing Harmful Effects on Sensitive Areas and Nontarget Organisms

- Sensitive Areas
- Pesticide Effects on Nontarget Organisms
  - Nontarget Plants
  - Bees and Other Beneficial Insects
  - Fish, Wildlife, and Livestock

### Protecting Endangered Species

### Summary

### Review Questions

---

### CHAPTER 8 TRANSPORTATION, STORAGE, AND SECURITY

- Transportation
  - Transport Vehicle
  - Vehicle Operator
  - Other Safety Precautions
  - Vehicle Placards
- Storage of Pesticides in Buildings
  - Secure the Site
  - Prevent Water Damage
  - Control the Temperature
  - Provide Adequate Lighting
  - Use Nonporous Materials
  - Maintain the Storage Site
  - Keep Labels Legible
  - Store Pesticide Containers Safely
  - Look for Damage
  - Note Shelf Life of Pesticides
  - Follow These Safety Tips
  - Isolate Unwanted or Waste Products
- Pesticide Site Security
  - Benefits of Security Efforts
  - Risk Assessment
  - Employee Training and Security Awareness
  - Evaluating Pesticide Security
  - Steps to Prevent Security Problems
- Summary

### Review Questions

---

### CHAPTER 9 EMERGENCY OR INCIDENT RESPONSE

- Emergency Response Planning
- Fires
  - Precautions to Reduce Fire Hazards
- Pesticide Spills
  - Control the Spill
  - Contain the Spill
  - Clean up the Spill
  - Prevent Spills
- Summary

### Review Questions
CHAPTER 10  PLANNING THE PESTICIDE APPLICATION .  143
Selecting the Pesticide ................................. 144
Reviewing the Pesticide Label ......................... 144
Determining Pesticide Compatibility .................. 144
  Conducting a Compatibility Test .................... 145
     Making Tank Mixes
Following Safe Mixing and Loading Practices .......... 146
  Select an Appropriate Mixing and Loading Area ...... 146
  Protect Water Sources .............................. 147
  Use Personal Protective Equipment ................. 147
  Opening Containers Carefully ....................... 147
  Measure Accurately ............................... 148
  Transferring Pesticides Carefully ................... 148
Cleaning and Disposing of Pesticide Containers ....... 148
  Container Rinsing Procedures ..................... 149
Applying Pesticides Correctly ......................... 149
  Personal Protective Equipment ....................... 149
     Hand-Carried and Backpack Applications
     High-Exposure Applications
     Application Procedures .......................... 150
Cleaning up after Mixing, Loading, and Application .... 151
  Cleaning Procedures ................................ 151
     Rinsates
     Equipment Cleanup
Professionalism ..................................... 153
  What is Professionalism? ......................... 153
  Demonstrate Professional Ethical Standards ......... 153
  Communicate with Customers, Neighbors, and the Public 154
Summary ............................................. 154
Review Questions .................................... 155

CHAPTER 11  PESTICIDE APPLICATION PROCEDURES .  157
Application Methods .................................. 157
Safety Systems ...................................... 158
  Closed Mixing and Loading Systems ............ 158
     Mechanical Systems
     Water-Soluble Packaging
     Enclosed Cabs ................................. 159
  Pesticide Containment Systems .................. 159
Application Equipment ................................ 160
  Sprayers ......................................... 160
  Sprayer Components ............................. 161
  Granular Applicators ............................. 162
  Other Application Equipment .................... 162
Equipment Calibration ................................ 163
Calculating Area .................................... 164
  Rectangular Areas ............................... 164
  Triangular Areas ............................... 164
  Circular Areas ............................... 164