Alaska
Pesticide Research
Manual

Category Fourteen

Individuals who act as a pesticide consultant or apply pesticides on property other than their own must obtain certification from the Alaska Department of Environmental Conservation (ADEC) Pesticide Program. Applicators who apply restricted-use pesticides, regardless of location, must also be certified.

Category Fourteen, Pesticide Research, is intended for researchers conducting **field studies** with pesticides.

The information needed to successfully complete the written core examination required for all certified pesticide applicators in Alaska includes:

1. National Pesticide Applicator Certification Core Manual;
2. Alaska Core Manual; and
3. State of Alaska Pesticide Regulations in Title 18, Chapter 90 of the Alaska Administrative Code (18 AAC 90).

Because the individuals certified in Category Fourteen are involved with conducting experiments, it is expected that applicators in this category have extensive knowledge about pesticides, pests, and methods, as well as regulations and requirements related to pesticides.

The information needed to successfully obtain certification in Category Fourteen in Alaska includes:

1. This Alaska Manual;
2. Oregon Pesticide Safety Education Program *Demonstration and Research Pest Control Manual;*
3. Washington State University manual *Turf and Ornamental Weed Management Principals Manual*; and
4. Washington State University manual *Introduction to Insect and Disease Management Manual.*

CALCULATIONS

Precise and accurate application is important for every pesticide application. Strong math skills, including the ability to calculate speed, volume, odd shaped areas, mixing ratios, rates of application, etc. will be necessary to successfully pass the Category Fourteen examination. You will need to carefully review pages 164-165, and 190-192 in the National Core Manual. Additional resources for pesticide applicator math are available online from the Purdue Pesticide Program.

OREGON *DEMONSTRATION AND RESEARCH PEST CONTROL MANUAL*

Portions To Disregard

Oregon state rules, requirements, and regulations cited in the Oregon manual do not apply in Alaska, and should be disregarded. Use of pesticides in Alaska is regulated under 18 AAC 90.

You may also disregard the following sections or pages of the Oregon manual, as they do not apply in Alaska:

- **Pages 13-14**, covering information on Licensing, Recordkeeping, and the Pesticide Use Reporting System. This information applies only to Oregon Laws and Regulations. Licensing and recordkeeping requirements for Alaska are covered in the Alaska Core Manual.
- **Pages 17-20**, covering information on Oregon Experimental Use Permits, EUP Notification, and Special Conditions, Regulation, and Enforcement. This information applies only to Oregon Laws and Regulations.
- **Appendix F Pesticide Contacts**; covering Oregon Emergency Response Center contact information. This information applies only to Oregon.

Learning Objectives:

- List five or more goals for use of data generated from pesticide research experiments.
- Explain why food or feed crops used in experiments usually must be destroyed.
- Explain why areas treated experimentally may not be used for grazing.
- Describe the pesticide experiment size and conditions that would require a federal Experimental Use Permit (EUP).
- Explain the circumstances when Good Laboratory Practice Standards must be adhered to.
- Define the terms
    - Good Laboratory Practice Standards (GLPS)
    - study
    - test substance
    - test system
    - test facility
    - control substance
    - carrier
    - raw data
    - specimens
    - sponsor
    - study director

- List and describe the 15 items that must be included in each study protocol under 40 CFR 160, Good laboratory practice standards.
- List the three things that a pesticide must be able to do, in order to be effective against a pest.
- Define the terms pesticide selectivity and pesticide resistance.
- Describe some techniques for reducing pesticide resistance.
- Explain what a mode of action is.
- Define the term metabolism.
- List some factors that degrade pesticides.
- Define the term biological magnification.
- Explain what is meant by synergistic interactions, and antagonistic interactions. Tell whether herbicide interaction is synergistic or antagonistic when interacting with insecticides or with fungicides.
- Explain why calibration or mixing errors have more impact on small plots than large ones.
- Describe how to determine when nozzles on a boom sprayer should be replaced.
- Describe the process for calibrating a sprayer.
- List the fundamental steps of research experiments.
- Explain why it is not possible to prove whether a hypothesis is true.
- Explain the difference between empirical and observational experiments.
- List some characteristics of good experimental design.
- Define the terms
    - experimental unit
    - control
    - plot size
    - replication
    - randomization
- Explain some factors that should be considered when determining plot size.
- Explain why replication is necessary for accurate results.
- Explain why randomization is necessary for accurate results.
- Define and explain the advantages and disadvantages of the following types of experimental design: completely randomized design, randomized complete block, split plot, split block, and Latin square.
- Define the terms
    - bias
    - variable
    - value
    - population
    - sample
- Describe some techniques to reduce experimental bias.
- Explain the difference between census counts and probabilistic sampling.
- Define the terms and explain advantages and disadvantages of
    - simple random sample
    - stratified random sample
    - systematic sample
    - cluster sample

- multi-stage sampling

WASHINGTON STATE UNIVERSITY *TURF AND ORNAMENTAL WEED MANAGEMENT PRINCIPALS MANUAL*

Portions To Disregard

You may disregard pages 43-44, of the Washington State University *Turf and Ornamental Weed Management Principals Manual*, which includes information about Washington State regulations. These regulations do not apply in Alaska.

Learning Objectives

Basic Weed Science

- Describe what a weed is.
- Explain why introduced plants can be more problematic in a landscaped area.
- List some ways that seeds spread.
- List the characteristics of weed seeds that make them difficult to eradicate.
- Describe the identifying characteristics of a grass.
- Describe the identifying characteristics of a broadleaf plant.
- Describe the difference between an annual plant and a perennial plant.
- Describe the various ways that perennial plants may spread that do not involve seeds.

Herbicides

- Describe the difference between contact herbicides and systemic herbicides.
- Explain why it is important to get uniform coverage of the entire plant with a contact herbicide.
- Describe some ways that soil applied herbicides can be incorporated into the soil.
- Describe the difference between selective and non-selective herbicides.
- Explain how some of the characteristics of plants affect herbicide selectivity.
- Explain how application factors such as application rate, timing, and location affect herbicide selectivity.
- Explain how chemical factors such as formulation and use of adjuvants can affect herbicide selectivity.
- For each of the following modes of action, explain how they work to control weeds, and list some common pesticides with this mode of action: growth regulator, amino acid synthesis inhibitors, lipid inhibitors, seedling growth inhibitors, photosynthesis inhibitors, and cell membrane disruptors.
- Explain why it is important to know the 17 different herbicide groups.

Herbicide Performance

- Define and explain the difference between adsorption and absorption.
- Explain why herbicides are least likely to adsorb to sand, and most likely to adsorb to clay.
- Explain why herbicides are more likely to adsorb to soils with high organic content.
- Describe the type of soil which herbicides are most likely to leach through.

- Explain why higher air temperatures can lead to less herbicide selectivity.
- Explain why rainfall can result in poor weed control for both foliar and soil-applied herbicides.
- Explain how humidity can affect herbicide efficacy.
- Explain how wind can affect herbicide efficacy.
- List the four growth stages of a weed.
- Name the growth stage of an annual weed that is most susceptible to control efforts.
- Explain why it is important to know when plant sugars flow from leaves towards the roots in perennial plants.
- Name the growth stages of a perennial weed that are generally most susceptible to herbicides, and explain why.
- Name the part of a cut stump that should be treated with herbicide to prevent re-growth, and explain why treating this area is effective.
- Explain the difference between herbicide tolerance, herbicide resistance, and herbicide susceptibility.
- Describe several techniques to help prevent the development of herbicide resistance.

Precautions

- List seven factors that may impact the amount of spray drift from applying herbicide.
- Define the term 'vapor drift'.
- Describe how humidity and temperature can impact vapor drift.
- List several techniques that will help prevent contamination of surface water.
- List some factors that can increase the chance of herbicide leaching into groundwater.
- Explain why it is advisable to dedicate application equipment to one type of herbicide.
- Explain how to dispose of rinsate from cleaning application equipment.
- Explain why wettable powders and other suspensions cannot be left in a sprayer tank without agitation.
- List some factors that determine the length of residual activity of an herbicide.
- List some precautions to take when using long-term residual herbicides.
- Define the term 'photodegradation'.
- Define the term 'microbial degradation'.
- Define the term 'chemical degradation'.
- Explain how adsorption, leaching, volatilization, uptake by plants, and soil pH can affect the persistence of herbicides.
- Describe several methods to help reduce levels of residual herbicide in soil.

Herbicide Application

- Describe the types of applications where a hand sprayer or backpack sprayer would be effective, and list advantages and disadvantages of this method.
- Describe the types of applications where a low-pressure boom sprayer would be effective, and list advantages and disadvantages of this method.
- Describe the types of applications where a high-pressure sprayer would be effective, and list advantages and disadvantages of this method.

- List the advantages and disadvantages of the following nozzle materials: tungsten carbide, ceramic, stainless steel, brass, nylon, aluminum.
- List the appropriate pressure range when operating flat fan nozzles.
- List the appropriate overlap required when operating flat fan nozzles, and explain why overlap is necessary.
- Describe the types of applications where a drop spreader would be effective, and list advantages and disadvantages of this method.
- Describe the types of applications where a rotary or centrifugal spreader would be effective, and list advantages and disadvantages of this method.

Calculations and Calibration

- Calculate irregular shaped areas and perimeters.
- Describe the steps for calibrating a granular spreader.
- State when nozzle tips should be replaced.
- List the three variables that determine sprayer delivery rate.
- State the best way to make major changes to sprayer flow rate.
- Describe the steps for calibrating a boom sprayer.
- Explain guidelines for tank mixing different herbicides.
- Explain the purpose of adjuvants, including stickers, spreaders, penetrants, and buffers.
- Calculate effective application rate and swath width of a granular spreader, application rate of a boom sprayer, and other example problems.

Turf Weed Management

- Explain why using a variety of grass species is important to ensuring turf health.
- Describe soil conditions necessary for turf health.
- State the rule of thumb for a good grass mowing height.
- State how deep soil water should penetrate after irrigating turf.
- Describe the conditions when turf should be dethatched.
- Describe the conditions when turf areas should be aerated.
- List some guidelines for use of herbicides to control broadleaf weeds in turf.
- List some guidelines for use of herbicides to control annual grasses in turf.

Ornamental Weed Management

- Explain how mulches and landscaped fabrics help control weeds.
- Describe the advantages and disadvantages of the different materials used as a physical barrier to weeds.
- List some guidelines for herbicide use in managing weeds in ornamental plant beds.

Woody Plant Management

- List some mechanical methods for controlling woody plants.
- Describe each of the following application methods: foliar, basal, frill, cut stump, soil.

WASHINGTON STATE UNIVERSITY *INTRODUCTION TO INSECT AND DISEASE MANAGEMENT MANUAL:*

Learning Objectives:

Insect Growth and Development

- List some of the beneficial roles that insects play.
- Define the terms exoskeleton, molting, metamorphosis, instar, nymph, larva, and cocoon.
- List the stages of simple metamorphosis.
- Give some examples of insects that undergo simple metamorphosis.
- List the stages of complex metamorphosis.

Insect Physiology and Structure

- Define the term spiracle.
- Explain ways that pesticides can affect the respiratory system of an insect.
- Name some pesticides that affect the nervous system of an insect, and explain why these products can be dangerous to humans or pets.
- Describe the body characteristics of most insects.
- Describe the body characteristics of most arachnids.
- List some common insects that have chewing mouthparts.
- List some common insects that have piercing-sucking mouthparts.

Insect Classification

- Describe characteristics of the following types of insects and insect relatives: grasshoppers, earwigs, thrips, true bugs, aphids/psyllids, leafhoppers/spittlebugs, scales/mealy bugs, white flies, moths/butterflies, beetles, flies/gnats/midges, ants, bees, sawflies, parasitic wasps, spiders, spider mites, eriophyid mites, and symphylans.

Damage

- List some symptoms or damage caused to plants by insects with chewing mouthparts.
- List some symptoms or damage caused to plants by insects with piercing-sucking mouthparts.
- Explain why insects with piercing-sucking mouthparts may help spread disease from one plant to another.
- Define the term secondary pest.

Factors Influencing Insects

- Describe how weather can affect insect populations.
- Define the terms predator, parasite, parasitoid, and host-specific.
- Explain why broad-spectrum insecticides may result in further pest problems.

Insecticides - General

- Explain how contact insecticides work.
- Explain how systemic insecticides work.

- Explain why systemic insecticides are generally more effective against insects with piercing-sucking mouthparts.
- Explain the difference between narrow-spectrum and broad-spectrum insecticides.
- Explain the difference between residual and non-residual insecticides.

Insecticides

- Explain some reasons why many inorganic insecticides are no longer considered safe to use.
- State an advantage of botanical insecticides.
- Describe characteristics of chlorinated hydrocarbons.
- Explain why there are few chlorinated hydrocarbons currently registered for use.
- State which classes of the synthetic organic insecticides are generally most toxic to humans.
- Describe a significant drawback to carbamate type insecticides.
- Explain how pyrethroids work to kill insects.
- Explain how spray oils work to kill insects.
- Name at least two types of insecticides that are systemic.
- Name a type of insecticide that tends to have a long residual effect.
- List some currently used active ingredients in each of the following type of insecticide: botanicals, chlorinated hydrocarbons, organophosphates, carbamates, pyrethroids, and microbials.
- Explain how insect growth regulators, insect attractants, and pheromones work to control insects.
- List some techniques to help prevent insecticide resistance.

Precautions

- Describe the characteristics of insecticides that are most hazardous to bees.
- Describe the timing and temperature characteristics when application of insecticides is least likely to harm bees.
- List some ways that pesticides can enter water.

Plant Diseases

- List the plant function and common diseases that occur in the following plant parts: roots, stems, leaves, fruit/seed.
- List some types of damage to plants that are NOT caused by pests.
- Define the terms pathogen, parasite, and saprophyte.

Plant Pathogens

- List some plant damage caused by fungi.
- List a beneficial activity of fungi.
- List some plant damage caused by bacteria.
- List a beneficial activity of bacteria.
- List some plant damage caused by viruses.
- Define the term vector.

- List ways that each of the following reach plants; fungi, bacteria, viruses, and nematodes.
- Describe the four factors that influence whether or not a pathogen that reaches and enters a plant will develop into disease.

Diagnosing Disease

- Explain why correctly diagnosing a disease is essential to effectively controlling it.
- Describe the following terms: necrosis, discoloration, overdevelopment of tissue, underdevelopment of tissue, and wilting.
- Name an organization that is available to help diagnose plant diseases.
- Describe the characteristics of the following symptoms: fungal leaf spots, bacterial leaf spots, powdery mildew, veinal chlorosis, pollution injury, chemical damage, shoot dieback, shoot blight, needle drop, needle injury, top dying, branch dying,

Disease Control

- List and describe some cultural and plant management principles that help prevent plant disease.
- Define the term tolerant.
- Describe the efficacy of chemical controls against fungus, bacteria, and viruses.
- Explain why fungicides are usually applied as protectants.
- List some currently used active ingredients in synthetic organic fungicides.

Before Using Any Pesticide

STOP

All pesticides can be harmful to health and environment if misused.

Read the label carefully. Use only as directed.