SECTION 1

CHAPTER 2

USING EQUIPMENT IN GENERAL PEST MANAGEMENT

LEARNING OBJECTIVES

After completely studying this chapter, you should:

- Know the basic types of pest management equipment and how they function.
- Know the benefits and limitations of pesticide application equipment.
- Know how to calibrate structural pesticide application equipment and why it is important.
- Understand how safety is part of every phase of equipment use.
- Know how to select the proper tool for a specific job.
- Be familiar with equipment maintenance to ensure safe, economical, and efficient use.

The most important part of a pest management program is the ability of a technician to use his knowledge of pest management along with well cared-for equipment and good supplies. A successful pest management program includes regular cleaning, calibration, and repair of tools; time, training, and planning are required to achieve the desired level of pest control.

EQUIPMENT FOR CONDUCTING PEST CONTROL INSPECTIONS

The inspection is the most critical phase of any pest management operation. To be effective in solving pest problems, you must correctly identify the pest, the locations and extent of the pest infestation, and the structural and/or environmental conditions encouraging pest problems. Therefore, professional pest management programs begin with professional inspections.

Equipment is necessary for conducting professional inspections and to enable you to gain access to structural areas and equipment voids to apply a treatment, if necessary.

Flashlight

Though simple in form and function, the flashlight is probably the most important piece of inspection equipment in the pest management industry. Many insects, rodents, and other pests are secretive by nature. They hide in inaccessible or difficult-to-reach areas. Rarely do such areas contain enough light to expose hiding pests or evidence of their presence. Thus, a flashlight is a must in all pest management operations. When used properly, it can make the difference between successfully solving a pest problem or overlooking a critical aspect of the problem and having to make several callbacks.

Select a heavy-duty, waterproof and corrosion-resistant flashlight. The flashlight should be durable and provide a strong light intensity—consider halogen bulbs.

Monitoring Traps

Monitoring traps have become one of the most important tools in structural IPM. These devices are tools that alert you to the severity of an insect infestation and to the location of insect hot spots. Monitoring traps can record the presence or absence of pests and/or the numbers of pests before and after a control program. This procedure assists in proving to you and the customer the overall effectiveness of the control program.

Traps are available that incorporate German cockroach ***pheromones*** (i.e., a chemical substance produced by an insect of the same species that will attract them to the trap). Other pheromone traps are available for various fabric and stored-product pests. As this technology advances, the industry is likely to see more pest-specific monitoring traps.

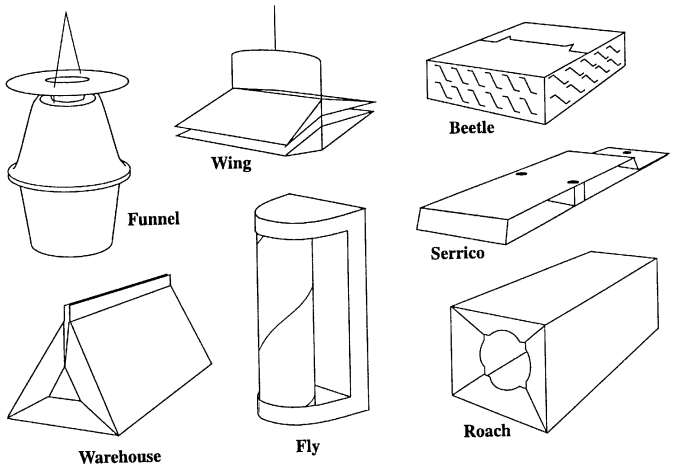


Figure 2-1. Several styles of pheromone traps are available, depending on the type of pest and on the location being monitored.

Flushing Agents

A flushing agent contains an insecticide that stimulates insects. Flushing agents are an essential inspection tool because they force insects from their hiding spots. In many cases, it is impossible to physically see into some insect habitats (e.g., hollow legs of tables, light sockets, cracks and crevices, and cabinet and wall voids). Only by using a flushing agent can you determine if insects are in these hidden places.

Hand Mirrors

A small, metal hand mirror enables you to see underneath, on top of, and behind equipment and objects. By reflecting the flashlight beam off the mirror, you can gain visual access into many out-of-sight areas, such as the inside corners of equipment, furniture, and air ducts.

Utility Tools

A small, portable tool set containing a few types of screwdrivers and ratchets allows you to disassemble various inspection plates, ventilation grills, and access panels for inspection or treatment purposes.

Inspection Diagram, Inspection Reports, and Building Plans

Inspection diagrams giving an overview of the structure and surrounding buildings and areas are often helpful. In some cases, inspection diagrams need only be an outline of the building and its surrounding environment. Such an overview often helps you see the big picture and thus to consider all the factors inside and outside the structure that may affect the pest problem. Diagrams also are invaluable in helping recall details at a later date.

Inspection reports should list the specific pests present, the extent of the infestation, the control tools and chemicals to be used, structural deficiencies contributing to the pest problem, and so on.

For pest management operations in large or complex buildings (hospitals, high-rise condominiums, schools, etc.), **building plans** enable you to visualize floors and rooms above, below, and on all sides of problem areas. Knowing where the utility lines, heating/cooling ducts, shaft connections, pipe chases, and so on are located helps to pinpoint warm and humid areas within the building. This, in turn, can aid in identifying the high-activity areas of insects that require such environments (e.g., pharaoh ants, cockroaches, silverfish, and others). Building plans are also valuable for determining entry points and migration paths of pests from one part of the building to another. Finally, building plans can serve as a checklist to organize large pest management programs and help to ensure that all pertinent areas of the building complex receive attention.

Miscellaneous Inspection Equipment

Where permitted, **cameras** are useful tools for documenting situations and building conditions that need to be corrected. A **ladder** should be kept on the truck to enable you to inspect above suspended ceilings, cathedral ceilings, and outdoor roof areas. Never use a customer's chair or ladder.

Moisture meters and sound detection devices may be useful when inspecting for wood-destroying insects. Many wood-infesting pests seek wood or structural environments with high levels of moisture and humidity. The sound devices can help you detect the sounds of the pest working inside wooden areas.

EQUIPMENT FOR APPLYING PESTICIDES

Regardless of how well trained and knowledgeable a pest management professional may be, effective pest management cannot be achieved unless the professional is backed up with high-quality and dependable equipment. It is essential to know how to choose equipment best suited to each job and how to use it properly and safely to obtain the best results.

Keep in mind that there are many types of pest management equipment, and each type may have many models. This chapter focuses only on the basic models of each equipment group. New equipment technology and improvements to existing equipment are on-going, so even well equipped professionals need to regularly reexamine equipment to benefit by new developments. To keep up-to-date, regularly review current trade magazines and equipment brochures, attend educational con-

ferences and seminars, and visit and talk with local pest management suppliers. These sources of information are invaluable to today's pest control operator.

SPRAYERS

Sprayers vary from the hand-pumped flit gun with a tank capacity of as little as one cup to large hydraulic machines powered by gasoline engines and with tanks that can hold several hundred gallons of pesticide formulation. All sprayers have basic characteristics in common. There is usually a tank, a device to pressurize the liquid, a delivery line leading to a valve, and another delivery line leading from the valve to a nozzle. All other items found on any sprayer, whether simple or complex, are merely accessories and are incidental to this basic design.

Hand-held Compressed-air Sprayers

The small (1- or 2-gallon) stainless steel spray tank is the workhorse of the pest control industry. It is the tool most familiar to pest control technicians. Nevertheless, the general trend in structural pest management seems to be moving away from the sprayers as the mainstay of insect control equipment. More emphasis is being put on monitoring, baiting, and various non-chemical control techniques, and sprayer technology is evolving into devices designed for much more precise applications.

The hand-held compressed-air sprayer is used in many different ways. In pest management, the spray tank is used to apply a flushing agent or a residual pesticide. Depending on the nozzle selection, it applies various spray patterns; and depending on the amount of pumping, it delivers the pesticide under high or low pressure. A thorough understanding of the compressed-air sprayer—its basic construction, how it works, how to maintain it, and how to make repairs—can save time and money, and prevent misapplication.

Components. There are three major parts to the compressed air sprayer:

1. Tank.
2. Pump unit.
3. Applicator wand and hose.

The **tank** forms the body of the sprayer. Tank capacities range from ½ gallon to 3 gallons. Most professional tanks are made of stainless steel to resist the corrosive nature of many pesticide formulations. The tank serves two purposes: first, it is the reservoir for the spray mixture, and secondly, it acts as a pressure chamber. A **discharge tube** is attached on the inside of the tank. The air pressure inside the tank forces the spray mixture through this tube into the hose.

The **pump unit** consists of a **pump cylinder** containing a **plunger rod** and various soft **gaskets** and **valves**. The pump unit is hand-operated to generate air pressure inside the tank.

The **applicator wand** is made up of the **valve trigge**r and the **nozzle,** and it is connected to the tank via a synthetic rubber (usually neoprene) **hose** that acts as the delivery tube from the tank to the applicator wand. Some

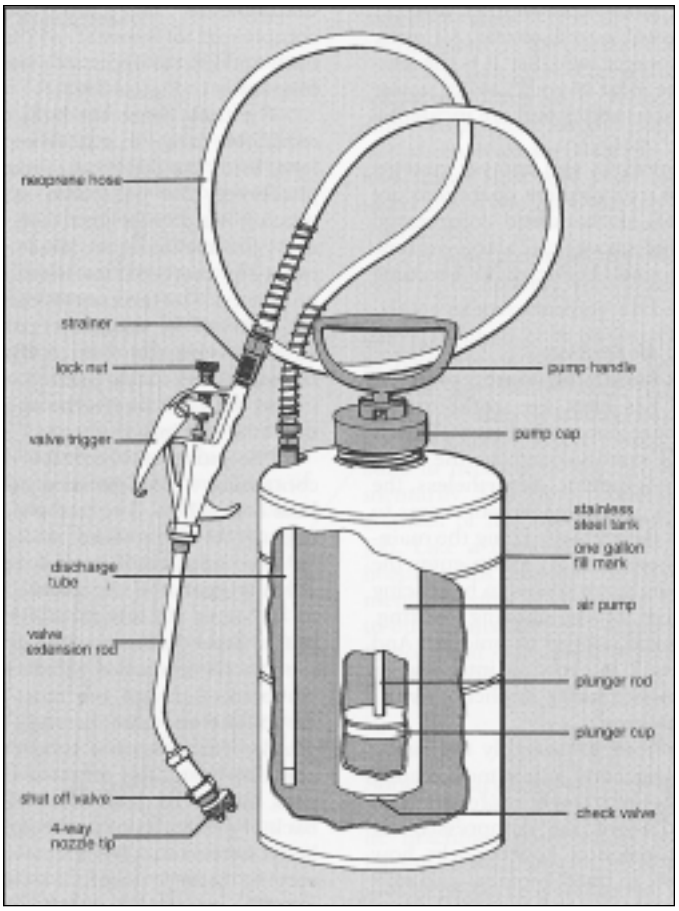


Figure 2-2. The major parts of a compressed-air sprayer (Provonsha).

wands are a stubby-nose design, but most sprayers today have an **extension tube** between the valve and the nozzle. The extension tube provides reach when applying pesticides on hard-to-get-to spots. It also helps reduce splash back of pesticides onto the applicator. Some manufacturers offer telescoping wands for convenience.

The **nozzle** is the smallest component on the sprayer, but it plays a very large role in proper pesticide application. Much of the effectiveness of a pesticide application depends on the proper functioning of the nozzle. Nozzle tips are designed to give specific shapes of spray at a set pressure. Most nozzles on the handheld sprayer offer a four-way multi-tip that can produce two different **pin-stream** spray patterns and two different **flat-fan** spray patterns. The applicator can easily and quickly change from a pin stream to a fan spray by rotating the tip.

Pin-stream nozzles produce solid streams of spray and are used to spray insecticides into various cracks and crevices. When set for fine spray, a stream is produced that can splash back from all but the widest cracks. Specialized nozzles are available with one pin-stream orifice adapted to the use of a plastic or metal **crack and crevice extension tube.** This is extremely useful because it permits the professional to apply pesticide directly into cracks and crevices with little worry of spilling or splashing pesticide on surrounding surfaces.

Flat-fan nozzles produce a fan-type spray pattern. These patterns provide an even coat of spray on flat sur-

faces, such as walls, and may also be used to apply pesticide into a crack wherever there is room enough for such application. Recognize that liquid dispersed into a crack using a fan pattern usually will not penetrate as deeply as when applied as a pin stream. Commonly on multi-tip nozzles, the smaller fan opening produces an 80 degree fine-fan spray pattern: the larger orifice produces 50 degree coarse-fan spray pattern. The coarse-fan orifice delivers more than twice as much spray per minute as the fine-fan orifice (see Table 2-1).

Table 2-1. The amount of spray delivered from a sprayer, depending on the nozzle orifice selected.

Pattern	Spray Angle	Oz of spray/minute @ 20 psi
Coarse fan	50 degrees	14.08
Fine fan	80 degrees	6.40
Broad pin stream	Straight	8.96
Fine pin stream	Straight	4.48
Crack & crevice straw	Straight	3.84
Aerosol-tip straw	Straight	7.04

Sprayer software is the various soft gaskets and valves contained within the application wand and pump unit. This software is critically important to the proper functioning of the sprayer. If sprayer software becomes worn, broken, or improperly installed, the sprayer will malfunction or constantly leak. Inspect sprayer software regularly and replace worn parts immediately.

Pressure. Spray tank air pressure varies according to the amount of air pumped into the tank. Pressure gauges can be attached to spray tanks. Low pressure is usually recommended for spray application inside structures. Constant use of high pressure with compressed-air sprayers sets up the possibility of overuse and misapplication. It causes part of the sprayed liquid to break into droplets as soon as it exits the nozzle; this wastes material, which can drift onto non-target surfaces. High pressure also causes splash back on surfaces or quickly traps air in crevices and keeps the pesticide from entering small spaces.

Establishing and maintaining **correct pressure** in the sprayer are important for obtaining good insect control and for safety. Keep in mind the following:

- Sprayer pressure affects the amount of insecticide applied and the type of pesticide coverage. Too much or too little pressure often causes spotty and uneven coverage, which results in poor insect control.
- High pressure is seldom necessary. Furthermore, excessive pressure may increase the hazards both to the applicator and to the public because of the possibility of hoses bursting under pressure. Also, insecticide particles at high pressures tend to bounce off the target surface. This is wasteful and dangerous—the pesticide may drift onto other people, objects, food, or food preparation surfaces.
- Continual excessive pressure on the sprayer causes premature wear and possible damage to the sprayer software.
- Some insecticide labels dictate the particular pressure appropriate for applications against specific pests.
- Always wear the appropriate personal protective equipment (PPE) as specified by the label and/or required by Regulation 637.

Sprayers should be equipped with a **pressure gauge.** The gauge allows the applicator to control and monitor the pressure in the tank at all times. This is important not only to prevent using excessively high pressures but also to monitor the pressure drop in the tank when the pesticide is being sprayed.

The correct pressure for the sprayer varies according to the type of insecticide application. For example, for crack and crevice treatments, pressures of less than 10 psi are most effective. Achieving pressures in this range requires only two to four strokes of the pump handle with a full 1-gallon sprayer.

General and spot treatments are most often performed using either the fine-fan or coarse-fan nozzle openings. A general, effective operating pressure for fan spray applications is between 20 and 25 psi. This pressure produces a uniform spray pattern. Fine-fan applications at this pressure include flea treatments on carpeting; coarse-fan applications include treating along outside foundation walls. To achieve 20 to 25 psi on a full 1-gallon sprayer requires between nine and eleven strokes of the pump handle.

Routine Sprayer Use. Proper routine use of the sprayer is critical for effective insect control and safety, and for keeping the sprayer in good working order. The following discussion provides key basics for effective and safe daily use of the sprayer. Familiarize yourself with your equipment and be prepared to repair it.

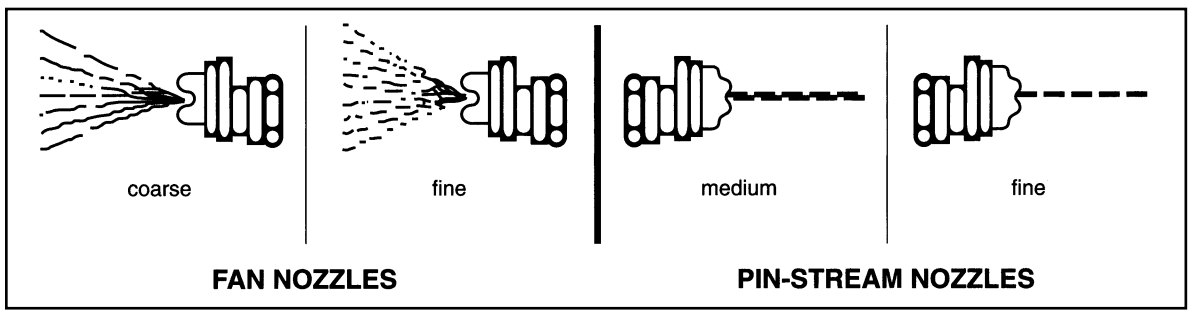


Figure 2-3. The spray patterns produced by the fan and pin-stream orifices on a four-way nozzle tip.

Correct **filling of the sprayer** is important to achieve a good mixture of water and insecticide. When filling the sprayer, follow these general rules:

- At the beginning of each workday, fill the sprayer with a little water and run a check to see that all components are working properly. This ensures safety, eliminates downtime, and prevents potential accidents.
- Never place the pump unit of the sprayer on the ground—it will collect dust, dirt, and possible contaminants that may clog the sprayer. Also, the pump may leave undesirable pesticide residue on the floor.
- When filling the sprayer, use clean water; allow the faucet to run for several seconds before collecting.
- Unless otherwise directed by the pesticide label, mix insecticide concentrates into the sprayer by first filling the tank about one-quarter full with cool water, then adding the concentrate, and then adding the remaining water.
- Never use warm water to mix sprays. Warm water helps break down pesticides, creates droplets that easily float, and increases a pesticide's odor.
- Fill the tank to only $^3/_4$ full of its total capacity. Most sprayers will have a 1-gallon indentation mark on the tank. The remaining 25 percent of space is used to build up air pressure.
- As emphasized in the Core Manual, always wear the appropriate PPE when working with pesticides. Always use safety glasses or goggles when treating areas above the head or close to the face.

When **using the sprayer** during the course of your workday:

- Always release the pressure from the sprayer if it is not used for an hour or more (e.g., over lunch). Hoses and gaskets deteriorate if insecticides are left in a sprayer under pressure for prolonged periods.
- If using different insecticide formulations (e.g., wettable powders, encapsulated pesticide, emulsions, etc.), use a separate sprayer for each type of pesticide. If not thoroughly cleaned when switching between a wettable powder and an emulsion, the sprayer may become clogged. Moreover, some insecticides, such as encapsulated formulations, require use of a large-mesh filter.
- Never pick up or carry the sprayer by the hose—this will stress and eventually cause breaks in the hose.
- Ensure that the supporting springs at both ends of the hose are always in place to prevent crimping and breakage of the hose.
- Never leave a sprayer in a vehicle for prolonged periods (e.g., overnight) in freezing temperatures. Severe damage to the tank, hose, and application wand can result.
- Keep a **sprayer repair ki**t readily available.
- Give special care to nozzles that become clogged. Nozzle tips are usually made of brass, a relatively soft metal that allows tips to be easily damaged. Never use metal objects to clean the nozzle. Unclog a nozzle either by back-flushing with water or by using a soft- bristle brush.
- Always attempt to calculate the amount of spray needed for the day's work schedule to avoid having material left at the end of the day. This precaution saves on chemical costs and eliminates the need to dispose of and/or store insecticides. Ideally, all insecticides should be used up on the job without over applying.
- Use the safety locknut, if there is one on the spray unit. When tightened, the locknut prevents the trigger from being accidentally activated and discharging pesticides.
- At the end of each workday, release the pressure and rinse the sprayer with water, especially the hose. Always empty liquid from the hose: hold the nozzle high and squeeze the trigger to drain the hose. If this is not done, liquid from the last use remains; it will be applied first at the next use, regardless of any new spray mix in the tank.
- Clean the sprayer on a regular schedule.

Backpack Sprayers

Backpack sprayers or knapsack sprayers are also commonly used in pest management operations, although not to the extent of the 1-gallon hand-held sprayer. Tank capacities usually range between 2 and 5 gallons. They are designed for continuous spraying of large areas.

Backpack sprayers are commonly used for applying herbicides and/or insecticides on lawns, along fences and building perimeters, and so forth. They may also be used for indoor pesticide and disinfectant spray applications, such as in large commercial food facilities and warehouses.

Most backpack sprayers use a specialized hand-operated lever to prime a piston pump to pressurize the sprayer. Depending on the model, pressures up to 150 psi can be generated, although working pressure on most is usually between 40 and 75 psi.

Because backpack sprayers are not the choice for precision applications using low pressures (such as crack and crevice applications), only two types of nozzle openings are usually available—flood jets and cone nozzles.

The cleaning and maintenance of backpack sprayers are similar in principle to those described for the hand-held sprayer. Consult the owner's manual for specific instructions.

Power Sprayers

As their name implies, power sprayers use electric or gasoline engines to pump liquid insecticides from a relatively large tank, usually over 100 gallons. The liquid is discharged through a $^3/_8$- to $^1/_2$-inch hose of sufficient length to reach from the pump to the application site. Power sprayers are generally used for one of two types of structural pest control: (1) controlling termites, and (2) spraying building perimeters and lawns.

Spraying outside also treats other types of outside pests (e.g., ticks, crickets, millipedes, and other miscellaneous invaders). Here too, low pressure is more effective than high pressure because the pesticide will not blast away the surface dust or soil and runoff. Low pressure allows for a more careful application, better soaking action, and better penetration through short grass.

Special attention should be paid to the hoses of power sprayers—both in the quality and points of wear. Wear or cuts cause hoses to burst. Shut-off valves must be in good working order. Be prepared and carry equipment (e.g., spill pad) to take care of spills in the service truck.

EQUIPMENT CALIBRATION

Why Calibrate Spraying Equipment?

Calibration is the process of measuring and adjusting the amount of pesticide your equipment will apply to a specific area. In structural pest management, much is up to the judgment of technicians. A pest control technician should know that the proper dosage of pesticide is being applied. Without accurate calibration of sprayers, the amount of pesticide delivered will be incorrect. Overdosage will contaminate the spray area or result in runoff. Less than recommended dosage might fail to control the pest. Technicians need to look regularly at the output of their equipment. Flow meters are very helpful to let the technician know the output of the sprayer over time.

- It is estimated that 60 percent of sprayers have a calibration error up to 10 percent.
- A large percentage of sprayers have greater than 10 percent variation in discharge from individual nozzles or tips.
- Application methods used by applicators vary, depending on pressure, nozzle tip, etc.
- Soil types and types of soil cover (grass, mulch, gravel) can influence the rate of pesticides a technician applies.

Manufacturers' instructions, university extension training meetings, label instructions and company policy should be considered and used to calibrate sprayers.

How to Calibrate Sprayers

Calibration does not have to be difficult. It can be accomplished by knowing:

1. How much spray mixture your sprayer applies per unit area.

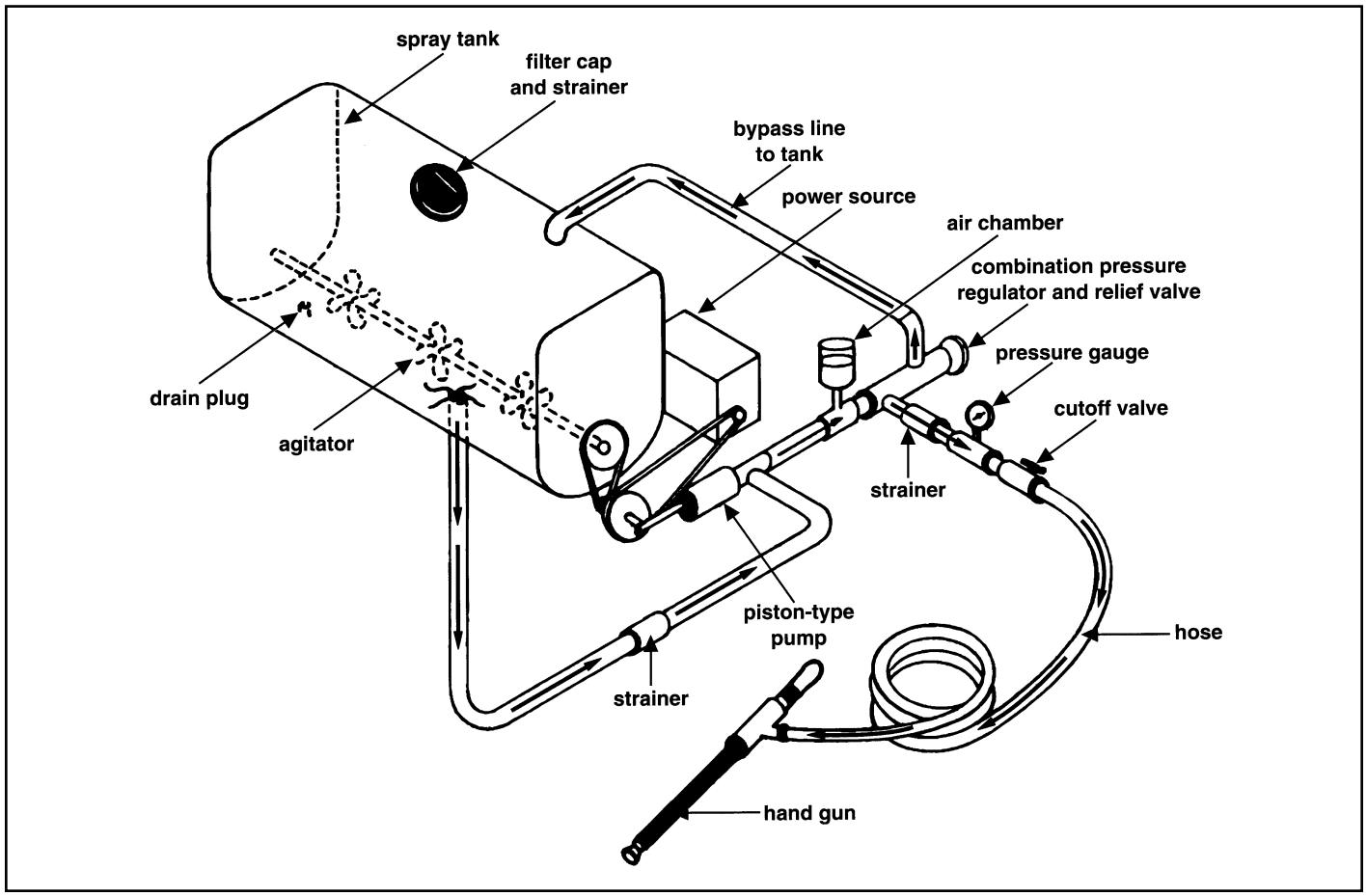


Figure 2-4. A schematic illustration of a simple power rig.

2. How much area you can spray per tank.
3. The recommended rate of pesticide application as specified by the label.
4. The amount of pesticide product to add to the spray tank.

The amount of spray applied per unit area is determined by the **nozzle flow rate.** The flow rate through a nozzle varies with the nozzle pressure and the size of the nozzle tip (see Table 2-1). Increasing the pressure or using a nozzle tip with a larger opening will increase the flow rate.

Increasing pressure will not, however, give you a proportional increase in flow rate. For example, doubling the pressure will not double the flow rate; you must increase the pressure fourfold to double the flow rate.

Pressure cannot be used, therefore, to make major changes in spray rate but it can be used to make minor changes. Keep in mind that you must maintain operating pressure within the recommended range for each nozzle type to obtain a uniform spray pattern and minimize drift.

The easiest and most effective way to make a large change in flow rate is to change the size of the nozzle tip. Depending on operating pressure, small changes in nozzle size can significantly change sprayer output. Nozzle manufacturers' catalogs can be used to select the proper tip size.

Travel speed is another important variable that affects the amount of pesticide applied. The application rate is inversely proportional to travel speed; that is, if you cut your travel speed in half, you will double the amount of mix applied per unit area. Travel speed, however, becomes less critical with most structural pesticide applications because the spray mixture normally is applied on a percentage basis and to the point of runoff. Still, a uniform walking speed must be maintained during such applications.

Precalibration Check. After making sure that your spray is clean and the correct nozzle for the intended application is installed, partially fill the tank with clean water. Operate the sprayer at a pressure within the recommended range and check the uniformity of the spray pattern. A worn or partially plugged nozzle will produce non-uniform patterns.

Liquid Application on a Percentage Basis. Structural insect control recommendations are commonly expressed as a percentage of active ingredient in the total spray mixture. The pesticide manufacturer usually provides a spray dilution chart on the label that lists the amount of formulated product that needs to be mixed with various quantities of diluent (usually water) to provide the desired spray mixture. Thus, insecticide mixtures can be prepared directly from label directions without the need for calculations.

Calibration of Hand-held (Single-nozzle) Sprayers

When applying pesticides on a percentage basis, you apply the spray mixture onto the site to the point of runoff. Thus, making a uniform application is much more important than knowing the actual output of the sprayer. However, if you ever apply pesticides on a unit area basis (e.g., per 1,000 square feet), then you will need to know how much area your sprayer will cover per tankful before you can determine how much pesticide product to put in the tank.

You can calibrate a hand-held sprayer by following these steps:

1. Measure a suitable test area similar to that which you will be spraying. A minimum test area of 10 feet by 25 feet (250 square feet) is suggested.
2. Fill the sprayer with water to a level that is easily recognized.
3. Spray the premeasured area using the same pressure and technique that you will use when applying the pesticide.
4. Refill the tank (with water) to the original water level. Be sure to note how much water you added to refill the tank.
5. Multiply the volume used for the test area by the appropriate number to get the volume of spray mixture you will need to spray 1,000 square feet. Change nozzles or adjust speed or pressure and recalibrate if necessary.
6. Determine the amount of pesticide needed for each gallon of water and the amount of spray mixture needed to cover the intended spray area.

Example: Your sprayer delivered 1½ gallons of water over 250 square feet. The insecticide label recommends that 12 ounces of liquid product be mixed in enough water to cover 1,000 square feet. Assume the spray capacity is 3 gallons.

1. What is the volume of application per 1,000 square feet based on the test area sprayed?

   Volume per 1,000 square feet = volume per 250 square feet x 4.
   = 1.5 gallons x 4
   = 6 gallons

2. How many ounces of insecticide are needed per gallon of water?

$$\text{Amount needed per gallon} = \frac{\text{amount needed per 1,000 square feet}}{\text{volume sprayed per 1,000 square feet}}$$
$$= 12 \text{ ounces} / 6 \text{ gallons}$$
$$= 2 \text{ ounces/gallon}$$

3. How many ounces of insecticide must be added to a full tank of water?

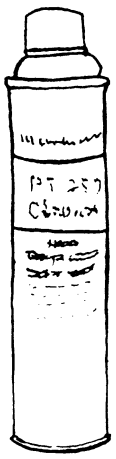
   Amount per tank = tank capacity x amount needed per gallon
   = 3 gallons x 2 ounces per gallon
   = 6 ounces per tank

4. How much area will one tank (3 gallons) of spray cover? Remember, the sprayer was calibrated for 6 gallons of water per 1,000 square feet.

$$\text{Square feet per tank} = \frac{1{,}000 \text{ square feet}}{\text{gallons needed per 1,000 square feet}} \text{ x gallons per tank}$$
$$= \frac{1{,}000 \text{ square feet}}{6 \text{ gallons}} \text{ x } 3$$
$$= 500 \text{ square feet per 3-gallon tank}$$

CANNED INSECTICIDES

Pressurized cans of insecticides became common in the late 1940s and were first used as aerosol foggers or "insect bombs." Canned insecticides in structural pest management include canned aerosol foggers (volumetric sprays, total release fogs), and pressurized liquid sprays. (The garden-type aerosol or the over-the-counter aerosol generally sold to the public for contact spraying is NOT included in either of these categories.)

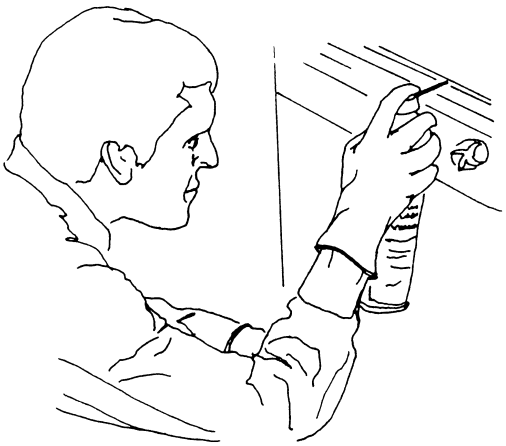


Canned Aerosol Pesticides

Canned aerosol pesticides consist of a pressurized fluid that produces an aerosol or fog droplet that floats in the air for a period of time, then settles to the ground. The droplet size is governed by the nozzle and valve at the top of the can. After use, a more or less uniform coverage will be attained on exposed horizontal surfaces. Very little pesticide lands on vertical surfaces, penetrates opened cabinets, or clings to undersurfaces. Droplets contact pests that have left hiding places; other insects that fly into the insecticide are also killed.

Canned-pressurized Liquid Sprays

Canned-pressurized liquid sprays are not aerosols. Because the coarse, wet spray is not made up of aerosol droplets, little becomes airborne. Com-pressed gas mixes with the pesticidal liquid in a pressurized spray. The gas forces the pesticide through the exit port, quickly vaporizes, and leaves pesticide on surfaces. When canned-pressurized liquids are part of a system that includes crack and crevice nozzles, the insecticide can be placed precisely on the target area. Using canned-pressurized liquid sprays requires a firm understanding of the target pests' habits so that pest habitat can be treated.



AEROSOL AND FOG GENERATORS

Power aerosol and fog generators break liquid pesticides into aerosol droplets. Reducing the liquid into droplets is done either mechanically (cold foggers) or by using heat (thermal foggers). Caution should always be taken to protect the applicator's respiratory system when these generators are used.

Cold Foggers

Cold foggers break an insecticide into aerosol-sized droplets and propel them into the air in a light cloud or fog. Large, ultra low dosage (ULD) and ultra low volume (ULV) cold foggers are mounted on trucks and used in mosquito control programs, to control pests in large warehouses, and for fly control in some operations. Cold fog generators drive pesticidal fog over a relatively large area. Droplets fall on flying or resting mosquitoes or are deposited in very small amounts on plant leaves on which mosquitoes rest.

Hand-held cold foggers are used inside buildings where they fill rooms, small warehouses, etc., with aerosol droplets. These floating droplets kill flying insects as well as exposed insects on horizontal surfaces. Fogs do not enter tight spaces or cracks and crevices. While some aerosol generators are used for crack and crevice applications, they also produce aerosol droplets that float in the air.

Thermal Foggers

Thermal foggers use heat to vaporize oil in an oil-based insecticide formulation. Large truck-mounted thermal aerosol generators are used in mosquito control programs—the insecticide fog rolls across open spaces, killing flying insects as air currents move it. Indoors, portable thermal foggers work like cold foggers except that droplets are smaller.

Precautions. When using fogging or aerosol-generating equipment indoors:

- Applicators should wear respirators.
- Occupants must leave until the area has been adequately ventilated.
- Pets must be removed; houseplants and aquariums must be covered, and aerating pumps turned off.
- Exposed foods and food preparation surfaces must be protected. After treatment, food preparation surfaces and any exposed utensils must be washed.
- Pilot lights and any other open flames must be extinguished. This is particularly critical when the oil-based thermal fog is used. Any spark can set off a thermal fog atmosphere.
- Thermal fog generators can burn surfaces that are contacted, including the operator.
- Aerosol droplets will not move into spaces where air is not circulating nor into any dead-air cracks and crevices (e.g., under molding into partially closed cabinets, drawers, closets).
- Furnace, air-conditioning, and ventilation equipment should be turned off. Ventilation will evacuate the insecticide and may carry it to other places outside the target area.
- After an appropriate interval, and before people or pets reoccupy an area, treated rooms should be thoroughly aired.

For General Application

Fogging should not be used as a single method of treatment but as a supplementary method to other types of application. Fogging or aerosol application is a general pesticide application and only pyrethrins or insecticides labeled for unclassified application can be used in this way. If fogging treatments need to be used increasingly more frequently, it means that the pest population is not being suppressed and may be increasing.

DUSTERS

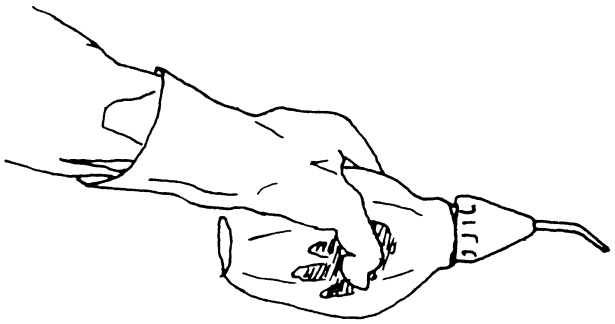
Dusters apply a fine, dry layer of a powdery mixture containing a small amount of pesticide. Dust applied on porous surfaces is not absorbed as liquids are—it rests on them like a layer of insecticidal powder. This dust accumulates on body parts (insect hairs, legs, and mouthparts) of insects that touch it. The insect absorbs pesticides in dusts in the same way as liquid sprays. Additionally, if the pest ingests particles (when grooming or cleaning itself), the dust can also cause stomach poisoning.

Hand Dusters

Pest management technicians commonly use three types of hand dusters: bulb, bellows, and plunger dusters. Dusts are also driven by gas in some formulations of canned insecticides, but with this method, dusts are applied the same as canned liquid pesticides.

Bellows dusters consist of a closed rubber cylinder made rigid by an internal spring, a spout at one end, and a stoppered refill hole at the other. These dusters, originally called Getz dusters, are held with the spout at the top. A slight pressure from top and bottom pushes air and dust from the spout. The more pressure applied, the more dust ejected. The spout is tapered at the tip, and slight puffs will propel small amounts of dust into cracks and crevices. The slight puffs distribute a thin layer of dust in the pest harborage.

Bulb dusters have a rubber bulb with a removable spout at one end. The spout screws off to allow for refilling. Dust application is similar to application with the bellows duster except that the bulb is squeezed. Both dusters come in several sizes.



Plunger dusters hold more dust than the first two hand-held dusters discussed. Plunger-type dusters have been used for garden dusting for a century, but the plunger duster used in structural pest management is smaller, made of high-impact plastic, and has several styles of nozzles.

Power Dusters

Most power dusters use compressed air to deliver insecticidal dusts to large spaces. Fire extinguishers have been converted to dusters and filled with compressed air. Other dusters are plastic and are pumped up similar to the hand-held compressed-air sprayer used to apply liquids. The plastic dusters release small or large amounts of dust with better control than the fire extinguisher type.

Dusts can be placed in wall voids, crawl spaces, and almost any unused space. Sometimes drilling into voids is necessary to inject dust. Great care must be taken to confine dust so that it does not drift and is not carried into non-target spaces. Remember to turn off pilot lights and flame- or spark-producing equipment if a combustible dust is used. Protect smoke alarms when using dust.

Dusters clog easily. They must be agitated often and the dust kept dry at all times. Dusters work much better if they are often washed and dried.

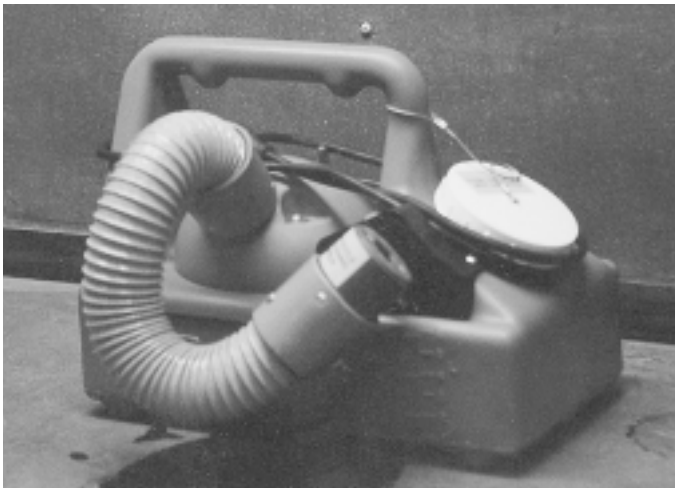


Figure 2-5. Power duster.

TRAPS

Traps, Bait Boxes, Monitoring Devices, and Pheromone Dispensers

Traps have been used for pest control for centuries. Rodent control traps range from snap traps to boxes that use trapdoors, spring-loaded multiple catch traps, and small animal traps. Rodent bait boxes, or bait stations, are containers that hold poisonous baits or glue boards. Under most conditions, they must be tamper-proof for safety. Other traps to catch pest birds are baited so the bird will enter and cannot get out. Fly traps are sticky tapes or cylinders that hang vertically, taking advantage of the fly's tendency to cling to vertical poles, strings, etc. Sticky traps are small glue boards used to catch cockroaches. These are used to monitor roach populations and to survey for other insects.

Pheromone traps lure insects with a pheromone (a natural attractant) to a sticky holding surface. These traps are used to evaluate insect populations. Their catches indicate which species are present. They may also be used to control or reduce pest populations.

Bait Stations

There are many kinds of bait stations. These devices confine toxic substances to units that are removable rather than leaving them exposed. In recent years, baits have become one of the most widely used formulations for cockroach and ant control. The bait stations offer natural insect habitat. They can augment sprays, dusts and fogs, or they can be used in place of other more toxic formulations. The key to using these devices is to know where and how to place them. Several products are now available that make baiting programs convenient, effective, and professional.

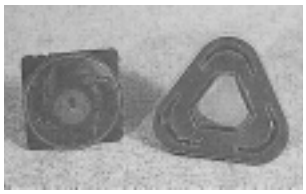


Figure 2-6. Bait stations for ants and cockroaches.

Bait Applicators

In addition to container baits and the powder bait formulations, two effective bait formulations are paste baits and gel baits. These formulations are packaged four ways:

1. Ready-to-use syringe-style cartridges—the applicator merely squeezes the syringe to apply the bait.
2. Containers of pastes—the professional, using a putty knife, applies the bait directly to the insect habitat.
3. Bulk paste baits—these can be loaded into a syringe that is then loaded into a bait applicator.

4. Prepackaged 30-gram and 100-gram bait tubes—these are easily loaded into the applicators.

Bait applicators (also referred to as bait guns) are available in several models. Dispensing tips on the guns allow the professional to apply baits into various types and sizes of cracks and crevices, which provides for effective pesticide placement into areas where the bait is most likely to be encountered by cockroaches.

SUMMARY

Using equipment safely and effectively in structural pest management requires special training and an understanding of the equipment being used. Equipment should be routinely inspected and maintained. Poorly cared-for equipment in bad repair is ineffective and dangerous.

To use pesticides efficiently and economically, without under application (lack of control) or over application (unsafe), applicators must understand the capabilities of their equipment and be able to depend on correct calibration. They must also be aware of the many types of equipment available. Sprayers, dusters, and foggers are just a few of the devices used in structural pest control. Other less toxic pest control devices such as traps and bait stations are being used more and more frequently. These may be used alone or in combination with other devices depending on the needs of the pest management program.

SECTION 1 CHAPTER 2

Review Questions

Chapter 2: Using Equipment in General Pest Management

Write the answers to the following questions and then check your answers with those in Appendix A in the back of this manual.

1-6. Match the following to the appropriate description:

A. Monitoring traps
B. Building plans
C. Inspection reports
D. Flashlight
E. Flushing Agent
F. Inspection Diagram

Which inspection tool would be the MOST appropriate for:

____ 1. Locating areas in the building that are warm and humid.

____ 2. Estimating the numbers of pests present before and after a control program (often uses pheromones).

____ 3. Listing the structural deficiencies contributing to the pest problem.

____ 4. Providing an overview of the structure and surrounding area.

____ 5. Viewing pests in their hiding places.

____ 6. Determining if pests are present in areas physically impossible to see.

7. Spraying is always considered essential to an effective structural pest management program.

A. True
B. False

8-12. Match the following to the appropriate description.

A. Backpack sprayer
B. Hand-held sprayer
C. Power sprayer

____ 8. Has a 2- to 5-gallon tank capacity and is pressurized by priming a piston pump.

____ 9. Uses a relatively large tank to spray building perimeters and lawns.

____ 10. Most likely sprayer to select for use indoors in smaller areas; pest control in cracks and crevices; applying flushing agents.

____ 11. Most likely sprayer to select for treating larger indoor areas (warehouses, commerical food facilities); outside, it is used on lawns, along fences, and around building perimeters.

____ 12. Produces two different flow patterns: pin-stream and flat-fan.

13. Which type of nozzle spray pattern delivers the largest amount of spray per minute at 20 psi?

A. Fine pin stream
B. Coarse fan, 50 degrees
C. Fine fan, 80 degrees
D. Broad pin stream

14. What is the advantage of using a crack and crevice extension tube on a nozzle?
    A. It allows crack and crevice application with little spilling or splashing.
    B. It is best for applying an even coat of spray on flat surfaces, including cracks.
    C. It delivers more than twice as much spray per minute to cracks and crevices.
    D. All of the above

15. High pressure must be maintained in hand-held sprayers to be effective.
    A. True
    B. False

16. New sprayers are well calibrated until they have been used one season.
    A. True
    B. False

17. A general effective pressure for fan spray applications is:
    A. Less than 10 psi.
    B. 10 to 20 psi.
    C. 20 to 25 psi.
    D. Greater than 25 psi.

18. For crack and crevice treatments, an effective pressure is:
    A. Less than 10 psi
    B. 10 to 20 psi
    C. 20 to 25 psi
    D. Greater than 25 psi

19. Which are proper procedures when filling a sprayer?
    A. Add the insecticide after completely filling the sprayer with water.
    B. Check to see that all components are working at the beginning of the day.
    C. Fill the tank to capacity.
    D. Use warm water to mix sprays.
    E. A & B

20. If a sprayer malfunctions:
    A. Repair it immediately.
    B. Increase pressure by pumping.
    C. Release pressure and do not use again until repaired.
    D. Use very soft, thin wire to clear nozzle after releasing pressure.

21. Equipment safety is best maintained by:
    A. Routine rinsing.
    B. Routine hose inspection.
    C. Scheduled cleaning.
    D. All of these.

22. What effect will increasing the pressure of a hand-held sprayer have on flow rate?
    A. Proportional increase in flow rate
    B. Decrease the flow rate
    C. Disproportional increase in flow rate
    D. Flow rate remains the same
    E. None of the above

23. What effect will increasing travel speed have on the pesticide application rate?
    A. Decrease application rate
    B. Increase application rate
    C. Application rate remains the same
    D. None of the above

24. What is the purpose of the precalibration check?
    A. Determine if equipment is operating properly
    B. Determine if insecticide is effective at controlling target pest
    C. Determine if spray application is uniform
    D. A & C
    E. A, B & C

25. Travel speed is less critical to structural pest management because the spray mixture is normally applied on a percentage basis and to the point of runoff.
    A. True
    B. False

26. In order to calibrate a hand-held sprayer, you must know:
    A. How much spray mixture your sprayer applies per unit area.
    B. How much area you can spray per tank.
    C. The rate of pesticide application as specified by the label.
    D. The amount of pesticide product to add to the tank.
    E. All of the above.

27. List the steps needed to calibrate a hand-held sprayer.

28. Your backpack sprayer tank holds 5 gallons. From calibrating your sprayer, you know that it applies 2 gallons of spray per 1,000 square feet. The labeling directions indicate a rate of 3 ounces of formulation per 1,000 square feet. How many ounces of formulation do you need per gallon of water? How many ounces per tankful?

29. How much area will one 5-gallon tank cover at a calibration rate of 2 gallons of spray per 1,000 square feet?

30. Fogging fills a room volume, including cracks, crevices and cabinets.

    A. True

    B. False

31-33. Match the following to the appropriate description:

    A. Canned-pressurized

    B. Fogging

    C. Dusting

_____ 31. Control mosquitoes over large areas.

_____ 32. A residual pesticide for places that are unused.

_____ 33. Crack and crevice nozzles allow treatment of insect habitat.

34. Bait stations have become one of the most widely used formulations for cockroach and ant control.

    A. True

    B. False