- Apply the pesticide only for the purposes listed and in the manner directed on the label.

FIFRA and the Use of Pesticides for Pests Not on the Label

The law regulating pesticides in the United States is the Federal Insecticide, Fungicide, and Rodenticide Act, or FIFRA. FIFRA is administered by the Environmental Protection Agency (EPA) and in Michigan by the Michigan Department of Agriculture (MDA). FIFRA governs the registration, distribution, sale, and use of all pesticides. A provision within FIFRA allows the use of a pesticide for a pest not noted on the label as long as the application is made to a crop specified on the label. This provision is referred to as 2(ee). All rates and restrictions for the labeled crop, including preharvest intervals, must be followed. Please note, however, that the manufacturer will not assume responsibility for product performance, so 2(ee) applications are made at the applicator's risk. For more information about 2(ee) applications, contact MSU Extension or the Michigan Department of Agriculture.

PROTECTING OUR GROUNDWATER

Many people who live in rural Michigan get their drinking water from wells. Well water is ***groundwater,*** so it is easy to see why you should be concerned about keeping pesticides out of groundwater. Groundwater is the water beneath the earth's surface occupying the saturated zone (the area where all the pores in the rock or soil are filled with water). Groundwater is stored in water-bearing geological formations called ***aquifers.*** It moves through the aquifers and is obtained at points of natural discharge such as springs or streams, or from wells drilled into the aquifer.

The upper level of the saturated zone in the soil is called the ***water table.*** The water table depth below the surface changes during the year, depending on the amount of water removed from the ground and the amount of water added by recharge. ***Recharge*** is water that seeps through the soil from rain, melting snow, or irrigation.

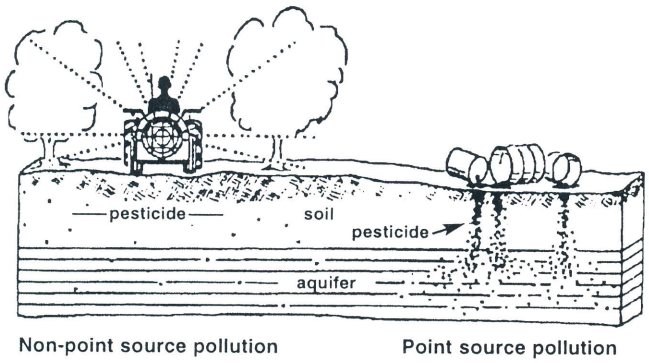

Figure 2.1. Point and non-point source pollution (Texas Agricultural Extension Service).

Surface waters are visible bodies of water such as lakes, rivers, and oceans. Both surface water and groundwater are subject to contamination by ***point*** and ***non-point source pollution.*** Point source pollution refers to movement of a pollutant into water from a specific site. Non-point source pollution refers to pollution from a generalized area or weather event, such as land runoff, precipitation, acid rain, or percolation rather than from discharge at a single location.

Keeping Pesticides Out of Groundwater and Surface Water

A pesticide that is not volatilized (becomes a gas), absorbed by plants, bound to soil, or broken down can potentially migrate through the soil to groundwater. The movement of groundwater is often slow and difficult to predict. Substances that enter groundwater in one location can turn up years later in other locations. A major difficulty in dealing with groundwater contaminants is that the sources of pollution are not easily discovered. The problem is occurring underground, out of sight.

It is very difficult to clean contaminated groundwater or surface water. Therefore, the best solution is to prevent contamination in the first place. The following practices can reduce the potential for surface and groundwater contamination by pesticides:

Use integrated pest management programs. Keep pesticide use to a minimum by combining chemical control with other pest management practices.

Consider the geology of your area. Be aware of the water table depth and how porous the geological layers are between the soil surface and the groundwater.

Select pesticides carefully. Choose pesticides with the least potential for leaching into groundwater or for runoff into surface water. Pesticides that are very soluble, relatively stable, and not easily adsorbed onto soil tend to be the *most likely* to leach. Read pesticide labels carefully, consult the MSU Extension pesticide application guides, or seek the advice of an MSU specialist or a pesticide dealer to help you choose the best pesticide for the purpose.

Follow label directions. The container label and any supplemental labeling accompanying the container carry crucial information about the proper rate, timing, and placement of the pesticide. Seek out and consult supplemental labeling as well as the container label before using the pesticide.

Calibrate accurately. Calibrate equipment carefully and often to avoid over- or underapplication.

Measure accurately. Carefully measure concentrates before they are placed into the spray tank. Do not "add a little extra" to ensure the pesticide will do a better job.

Avoid back-siphoning. The end of the fill hose should remain above the water level in the spray tank at all times to prevent back-siphoning of chemical into the water supply. Use an anti-backflow device when siphoning water directly from a well, pond, or stream.

Spray Pattern Uniformity

A uniform spray pattern is crucial for an effective pesticide application. It's not enough to apply a pesticide only in its correct amount—you also must apply it uniformly over the target area. The effects of non-uniform application are most obvious when herbicides are applied and streaking results. Spray pattern uniformity is affected by boom height, spacing and alignment of nozzles on the boom, condition of nozzles (worn, damaged), and operating pressure. Check that all nozzles are of the same type. Also, a frequent cause of poor spray patterns is using nozzles with different spray angles on the same boom.

To check the uniformity of the spray pattern, adjust the boom height for the spray angle and nozzle spacing being used. Align flat-fan nozzles at a slight angle to the boom. Using water, operate the sprayer at the desired speed and pressure on clean, dry pavement or on another smooth surface. Observe the spray pattern as the water evaporates. Clean or replace nozzle tips that produce a poor spray pattern; if necessary, readjust boom height and recheck the spray pattern. If you replace any nozzles, recheck the flow rates.

Broadcast Sprayer Calibration

There are a number of equally effective calibration methods that vary in their basic approach and degree of difficulty. For the purposes of this manual, we have chosen a simple method that will allow you to calibrate quickly.

1. Fill the sprayer tank approximately half full with water.
2. Determine the nozzle spacing or band width in inches and stake out the appropriate distance in the field according to the following table:

Broadcast nozzle spacing or band width (inches)	Travel distance (feet)
8	510
10	408
12	340
14	291
16	255
18	227
20	204
22	185
24	170
26	157

For other nozzle spacings or band widths, determine the appropriate travel distance using the following formula:

$$\text{Travel distance (feet)} = \frac{4{,}080}{\text{Nozzle spacing or band width (inches)}}$$

In this formula, 4,080 is a constant.

For example, if your nozzle spacing is 38 inches:

$$\text{Travel distance} = \frac{4{,}080}{38} = 107 \text{ feet}$$

Measuring the appropriate travel distance is a critical step in calibration. To determine what volume your sprayer is delivering for some land area (i.e., gallons per acre), you must relate the average nozzle output to a unit area of land. You could determine the volume output by physically spraying an entire acre, but this would be very time consuming. Therefore, we use a fraction of an acre.

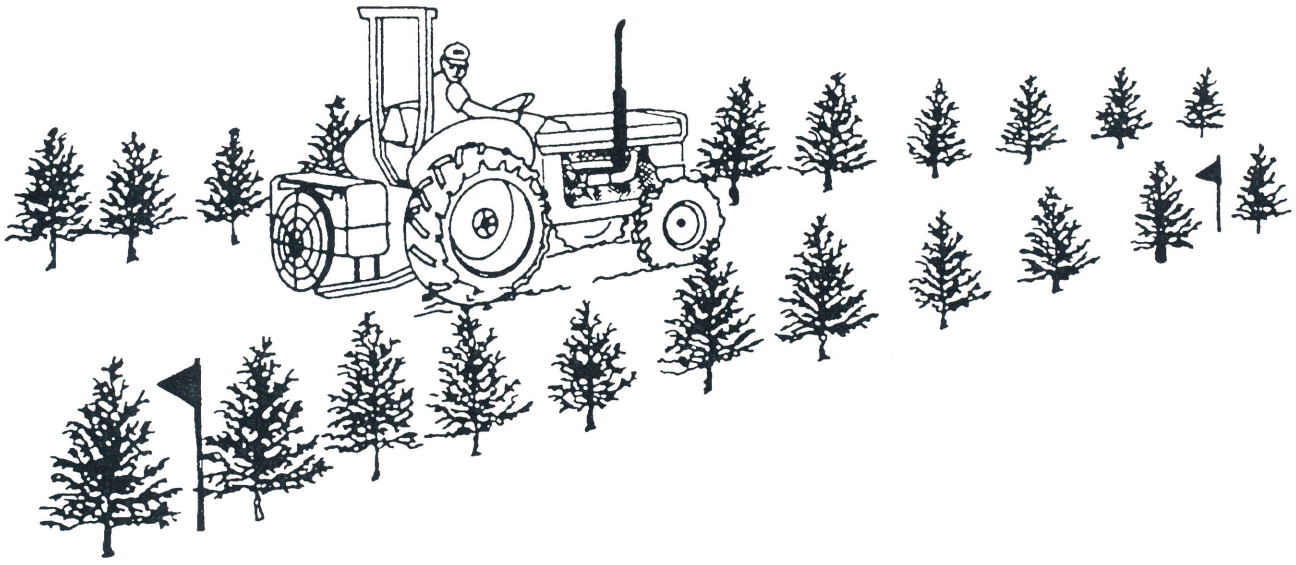

Figure 4.1. For calibration, drive the designated distance using the exact throttle setting and gear that are planned for the broadcast spray application.

programs emphasize communication, monitoring, inspection, and evaluation (keeping and using records).

JUVENILE HORMONE—A hormone produced by an insect that inhibits change or molting. As long as juvenile hormone is present, the insect does not develop into an adult but remains immature.

LABEL—All printed material attached to or on a pesticide container.

LABELING—The pesticide product label and other accompanying materials that contain directions that pesticide users are legally required to follow.

LARVA (plural larvae)—An early developmental stage of insects with complete metamorphosis. Insects hatch out of the egg as larvae before becoming ***pupae*** (resting stage) and then adults.

LC_{50}—Lethal concentration. The concentration of a pesticide, usually in air or water, that kills 50 percent of a test population of animals. LC_{50} is usually expressed in parts per million (ppm). The lower the LC_{50} value, the more acutely toxic the chemical.

LD_{50}—Lethal dose. The dose or amount of a pesticide that can kill 50 percent of the test animals when eaten or absorbed through the skin. LD_{50} is expressed in milligrams of chemical per kilogram of body weight of the test animal (mg/kg). The lower the LD_{50}, the more acutely toxic the pesticide.

LEACHING—The movement of a substance with water downward through soil.

MESOTHORAX—The second segment of an insect's ***thorax***. One pair of legs and usually one pair of wings are attached.

METAMORPHOSIS—A change in the shape or form of an animal. Usually used when referring to insect development.

METATHORAX—The third segment of an insect's ***thorax***. One pair of legs and often one pair of wings are attached.

MICROBIAL DEGRADATION—Breakdown of a chemical by microorganisms.

MICROBIAL PESTICIDE—Bacteria, viruses, fungi, and other microorganisms used to control pests. Also called biorationals.

MICROORGANISM—An organism so small it can be seen only with the aid of a microscope.

MITICIDE—A pesticide used to control mites. (See ***acaricide***.)

MODE OF ACTION—The way in which a pesticide exerts a toxic effect on the target plant or animal.

MOLT—Periodic shedding of the outer layer (e.g., an insect's ***exoskeleton*** is shed periodically).

MONITORING—On-going surveillance. Monitoring includes inspection and record keeping. Record keeping during monitoring allows evaluation of pest population suppression, identification of pest infestations, prediction of pest outbreaks from weather data, and management of the progress of the control program.

NECROSIS—Death of plant or animal tissues that results in the formation of discolored, sunken, or necrotic (dead) areas.

NON-POINT SOURCE POLLUTION—Pollution from a generalized area or weather event, such as land runoff, precipitation, acid rain, or percolation rather than from discharge at a single location. (See ***point source pollution***.)

NON-RESIDUAL PESTICIDE—Pesticides applied to obtain effects only during the time of treatment.

NON-TARGET ORGANISM—Any plant or animal other than the intended target(s) of a pesticide application.

NYMPH—The developmental stage of insects with gradual metamorphosis that hatches from the egg. Nymphs become adults.

ORAL TOXICITY—The ability of a pesticide to cause injury or acute illness when taken by mouth, one of the common exposure routes.

ORGANOPHOSPHATES—A large group of pesticides that contain the element phosphorus and inhibit ***cholinesterase*** in animals.

PARASITE—A plant, animal, or microorganism living in, on, or with another living organism for the purpose of obtaining all or part of its food.

PARASITOID—An organism that lives during its development in or on the body of a single ***host*** organism, eventually killing it.

PATHOGEN—A disease-causing organism.

PERSONAL PROTECTIVE EQUIPMENT (PPE)—Devices and clothing intended to protect a person from exposure to pesticides. Includes such items as long-sleeved shirts, long trousers, coveralls, suitable hats, gloves, shoes, respirators, and other safety items as needed.

PEST—An undesirable organism (plant, animal, bacterium, etc.); any organism that competes with people for food, feed, or fiber, causes economicl damage, is a public health concern, reduces aesthetic qualities, or impedes industrial or recreational activities.

PESTICIDE—A chemical or other agent used to kill, repel, or otherwise control pests or to protect from a pest.

pH—A measure of the acidity/alkalinity of a liquid—acid below pH 7; basic or alkaline above pH 7 (up to 14).

PHEROMONE—A substance emitted by an animal to influence the behavior of other animals of the same species. Examples are sex pheromones (to attract mates) and aggregation pheromones (to keep members of the same species together in a group). Some pheromones are synthetically produced for use in insect traps.

PHOTODEGRADATION—Breakdown of chemicals by the action of light.

PHYTOTOXICITY—Injury to plants caused by a chemical or other agent.