

Pesticide Application Best Management Practices for the Citrus Grove Worker¹

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What are Pests?

Pests in the Environment

A pest can be anything that consumes plant tissues and or competes with a citrus tree for nutrients, water, space or light. Pests are a reason for concern in citrus because they can reduce the amount and quality of fruit produced, and some diseases may even be fatal to tree if left untreated. The use of pesticides is one of many measures used to control pests. However, the pesticides that provide protection can also harm predators, animals, humans, and the environment if not applied correctly. The law provides protection from pesticides in the workplace. An established pesticide safety program should be a priority for the safety of all employees in the workplace.

Insects and Mites: Six and eight legged pests that chew or suck on the trees leaves, roots or the fruit surface. Rust mites, leaf notchers and Diaprepies root weevil are a few examples.

Fungi: Primitive plant parasites of the plant kingdom. Melanose and phytoptera (foot rot) are examples.

Weeds: Any plants (guineagrass for example) growing where they are not wanted competing for nutrients and water with the crop.

The environment is composed of much more than the oceans and the ozone layer. The environment contains air, soil, water, plants, animals, houses, restaurants, office buildings, and factories. Anyone who uses a pesticide--indoors or outdoors, in a city or in the country--must consider how that pesticide will affect the environment.

Questions to Ask Before Using Pesticides

- What is the best product and tactic to use for this pest situation?
- How will this pesticide affect the local environment?

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- What are the consequences of a pesticide moving off-site and causing damage to other environments?

Pesticides can damage environments if not used correctly. Responsible pesticide applicators know and follow good professional judgment to achieve effective pest control with minimal risk of environmental damage. Pesticide product labeling statements are intended to alert the applicator to particular environmental concerns that certain pesticide products pose.

Pest Control Methods

Successful citrus spray programs require choosing the proper pesticide material, pest abundance/vulnerability and the proper time to operate the spray equipment. Proper selection of crop protection materials, applied at the optimum time under acceptable weather conditions will provide a successful application. A modern way to look at best management is to consider and integrate a variety of control measures. This multitactic approach is referred to as Integrated Pest Management (IPM).

Control Measures

Prevention is a control measure when the pest's presence or population can be predicted in advance. Potential pests may be predictable if you know the circumstances or conditions favoring their presence. For example, some plant diseases can only occur under certain environmental conditions such as hot humid weather. When such conditions are present, control measures can be implemented to prevent plant disease organisms from harming desirable plants.

Suppression is the key to quality management situations. The key to this control measure is to reduce the number of pests to an acceptable level where the harm they cause is minimal. As scouting detects a pest's presence and control is deemed necessary, suppression and prevention often become joint goals in the effort to come up with the correct combination of control measures. These types of activities will suppress the pests to a level of acceptable harm.

Eradication is a radical control measure with the objective being complete elimination of the pest. It is difficult to accomplish. In most pest populations, control measures are prevention and suppression. Eradication becomes necessary when an invasive pest has been accidentally introduced, and is industry threatening, but has not globally established itself throughout an area. Such eradication control measures are supported by the government. Examples of this type of control measure are the mediterranean fruit fly, gypsy moth, and more recently, citrus canker and greening.

Pesticide Toxicity

Pesticides can cause harm, damage, or in certain cases even death. Safety laws and the pesticide label are intended to protect the worker or applicator. **The applicator must be willing to learn.** If pesticides are used in the workplace, supervisors are responsible for making sure workers and personnel are trained in pesticide safety. Before a pesticide is released by the EPA, many tests are conducted to determine the possible health and environmental risks. Chemicals, such as pesticides, can be absorbed through your skin and into your body. Small exposures that occur often over a long period of time is called chronic poisoning. Exposure to a high concentration that happen less frequently are referred to as acute poisoning.

Some pesticides are highly toxic to humans and just a few drops or granules in the mouth or on the skin can cause harmful or even lethal effects. Other pesticides are less toxic, but repeated exposure to them also will cause harmful effects. The key is for personnel handling pesticides to understand how to read a label and recognize the three signal words; Caution, Warning, and Danger.

The signal word indicates approximately how toxic the pesticide product is. Products that are highly toxic must display on the label the signal words DANGER-POISON along with a skull and crossbones symbol. Products that display only the signal word DANGER are corrosive and can cause irreversible eye damage or severe skin injury. Products that display the signal word WARNING are moderately toxic or can cause moderate eye or skin irritation. Products that display the signal word

CAUTION are slightly toxic or may cause slight eye or skin irritation.

Pests and Pesticide Toxicity Quiz

Multiple Choice

1. _____ is a goal when the pest's presence or abundance can be predicted in advance.
 - a) Suppression
 - b) Eradication
 - c) Prevention
 - d) Control
2. _____ is the intent is to reduce the number of pests to a level where the harm they cause is acceptable.
 - a) Suppression
 - b) Eradication
 - c) Prevention
 - d) Control
3. _____ Which of the following is considered a pest in a citrus grove?
 - a) Tall grass
 - b) Rust mites
 - c) Diaprepes
 - d) All of the above
4. _____ What are the three signal words found on Pesticide Labels?
 1. _____
 2. _____
 3. _____

True or False

_____ 5. Some pests reduce the quality and quantity of the fruit that is grown.

_____ 6. The goal of integrated pest management is to prevent an infestation and reduce the pests to an acceptable level.

_____ 7. Pesticides can harm the environment if not handled properly.

Transporting Pesticides Safely

Never carry pesticides in the passenger section of your car, van or truck. Noxious and hazardous vapors can be released making the driver and other passengers ill. Also pesticides can result in illness or injury if spilled or splashed on the driver or passengers. It is nearly impossible to completely remove spills from the fabric of seats and floor mats. These spills can cause future contaminations if they are not cleaned up correctly. Transport pesticides in a secure upright position and tightly close container lids to prevent spillage.

Label All Pesticide Containers

All containers must have the original product or the service container label.

Service container labeling requires the name and address of the person responsible for storage, the common name of the pesticide and the signal word from the original label.

Hazard or Risk = Toxicity x Exposure

A Hazard is the risk of harmful effects from pesticides. The term Hazard relates to the toxicity of the pesticide and the exposure level (time).

Types of Exposures

Pesticides can enter the body by four main routes:

1. Oral exposure: swallowing pesticides.

Preventive Measures: Washing hands before eating, drinking, smoking, chewing gum, etc. Never store or measure pesticide in food or drink containers.

2. Inhalation exposure: breathing in pesticides.

Preventive Measures: Masks, filters, respirators, etc.

3. **Ocular exposure:** pesticides in the eyes.

Preventive Measures: Faceshields, goggles, safety glasses, etc.

4. **Dermal exposure:** pesticides enter through the skin.

Preventive Measures: Long sleeved shirts, long pants, socks, coveralls, rubber gloves, rubber boots, plastic hats, plastic suits, etc.

First Aid and Decontamination

If illness occurs while working with pesticides, stop working immediately. Notify a supervisor or a fellow employee of the illness. Take the following steps to eliminate sources of continued pesticide exposure:

1. Go to a source of fresh air.
2. Remove contaminated work clothing.
3. Shower completely, including the hair, and change into clean clothing.
4. **DO NOT** put contaminated clothing back on until they are properly decontaminated. In some case clothing may need to be thrown out because it is unable to be decontaminated.
5. If shower facilities are not immediately available, use the closest available clean water source to wash the body. This may be water from a shower, faucet, hose or bottle. In emergencies an irrigation ditch or canal may be the only souce available but be caurful because they too may contain contaminants.

In all cases of pesticide illness, the instructions should be:

1. DECONTAMINATE IMMEDIATELY.
2. Put on fresh clothes.
3. Transport the victim to the nearest emergency medical care facility after decontamination is complete.
4. Do not leave the victim alone or allow them to drive.

5. Carry the pesticides label or MSDS sheet with the victim for medical information necessary to begin medical treatment.

If a person collapses while working with pesticides:

1. Immediately remove the worker from the pesticide use area.
2. Provide Cardio-pulmonary resuscitation, CPR, if the victim isn't breathing.
3. Call 9-1-1 for emergency help.
4. Warn emergency workers that the worker is possibly contaminated with pesticides.

More detailed information on First Aid procedures can be found in a document titled "First Aid for the Citrus Grove Worker" <http://edis.ifas.ufl.edu/AE242.pdf>

Preventing Pesticide Exposure

To prevent or reduce exposure to pesticides, it is mandatory to wear **Personal Protective Equipment (PPE)**. In fact, you are legally required to follow all personal protective equipment instructions contained on the label.

Proper PPE

Use rubber or plastic PPE made of materials such as butyl, neoprene, or polyvinyl chloride (PVC), non-woven fabric coated with plastic or another barrier material. Read the packaging for the PPE carefully to be sure they are "chemical resistant," "chemical protective" or "liquid proof."

Gloves

Gloves are one of the most important PPE worn by applicators because they reduce exposure up to 99%. Periodically test gloves for leaks by filling them with water and squeezing. Always tuck shirt sleeves inside gloves if working with hands raised and fold the glove ends over to form a cup that will catch any liquid running down the arm. When finished handling pesticides always wash off any chemical residues with soap and water before removing the gloves to avoid contaminating your hands.

Respirators

Pesticides can enter the body through breathing, through skin contact and by swallowing. Inhalation is the quickest and most direct route to the circulatory system. Respirators are made to protect your lungs from dust, mists, fogs and vapors. Because working with a respirator restricts breathing, workers should have a check up with a doctor to ensure physical fitness. People with cardiac or respiratory problems should not wear respirators. If unable to wear respirators when the label requires such devices be used, other activities should be selected which can be safely completed. Most importantly, always check with a doctor concerning any applicators ability to wear a respirator.

Chemical Protective Clothing

While working with certain low toxicity pesticides, long legged trousers and a long-sleeved shirts are recommended for minimum protection. An application of starch spray to clothing adds another protective barrier. The addition of cotton coveralls will reduce exposure even more. However for the best protection from pesticides that can penetrate clothing, wear a chemical-resistant suit. Ensure that the suit is large enough so it doesn't rip when stretching or bending. With the exception of **TYVEK** and other disposable chemical suits, always launder protective clothing every time you work with pesticides. Always launder contaminated clothing separately from family's clothing, use a heavy-duty detergent and hot water at the full water level. The washer should be cleaned prior to washing family clothing.

Eye Protection

For protection of the eyes from splashes and drifting dust, wear protective glasses with side and brow guards or, preferably, chemical splash goggles. While wearing protective glasses, a good fit is crucial. Both types of glasses or goggles should be anti-fog so they don't cloud and interfere with your vision. Neither have to be impact-resistant. For those applicators wearing prescription glasses, use a face shield or prescription protective glasses instead of goggles.

Protective Boots

Never wear leather or canvas shoes while working around pesticides. Canvas or leather will soak up chemicals, retain chemicals, making decontamination nearly impossible.

Additional information on PPEs can be found in a document titled "Personal Protective Equipment for the Citrus Grove Worker"
<http://edis.ifas.ufl.edu/AE243.pdf>

Worker Protection Standard (WPS)

Employers have guidelines for protecting applicators (those who handle pesticides directly) and workers (those who may be exposed to pesticides indirectly). The Worker Protection Standard (WPS) covers those who work in the production of agricultural plants whether it be a farm, a nursery, a greenhouse or a forest. General requirements of the standard include:

- Training of workers and handlers;
- PPE provisions;
- PPE maintenance;
- Decontamination sites;
- Chemical storage;
- Medical transport;
- Label interpretation;
- Dressing and changing facilities;
- Preventative heat stress education; and
- Posting field sites with placards of all chemical applications.

Restricted-Entry Intervals (REIs)

The restricted entry interval is the amount of time that must elapse after a product has been applied before personnel can enter that area without PPE. Early entry may be allowed when properly outfitted with protective clothing, always refer to the label for REI's and early entry requirements. Employers must ensure that all employees obey the Restricted-Entry

Intervals (REIs) which are found on the product label vary from product to product. Re-entry intervals range from 4 to 48 hours.

Notification

Employers are required to warn workers about pesticide-treated areas. In most cases, notification can be signs or by oral communication with workers. If highly toxic chemicals are in use, both types of notification may be required.

Decontamination

Employees must be provided with water (1 gallon per worker per day, or 3 gallons per handler per day), soap, and disposable towels for washing off splashed or spilled pesticides. A dressing room separately from the chemical storage facility is required for workers and handlers. This changing area should have a shower for decontamination.

Medical Emergencies

In case of pesticide emergencies, employers are responsible for providing the name and location of the nearest medical facility. Transportation to a medical facility, information concerning the pesticide(s) involved in the accident, and a label or MSDS sheet is also required by law.

Training

The WPS Training of employees must be accomplished every 5 years. However, the employer may opt for more frequent training sessions in efforts to operate more safely. Employers under WPS requirements will provide pesticide safety training, including training on the use of PPE. The training must be in a language that the worker can understand. The employer must also post a pesticide safety poster at a central location, provide access to label information, and post information about the pesticide applications made in that grove.

Pesticide Storage and Disposal

Locked Storage

Properly store or keep pesticides and empty containers under direct personal control at all times.

Direct personal control means a responsible person who can prevent access or contact by unapproved persons. A responsible person will have the pesticide(s) in sight, under direct personal control and be especially vigilant if the site is adjacent to a road or populated area.

Acceptable pesticide storage includes a locked, fenced area and a lockable storage facility. Warning signs must be posted on all storage areas containing pesticides with the signal words "DANGER" or "WARNING" on the label. Signs should be posted in all directions of possible approach. Signs should be large enough to be read from 25 feet away.

First Aid and WPS Quiz

Multiple Choice

1. _____ The safest place to store pesticides while you are working in the grove is?

- a) Inside your truck
- b) In the back of your truck
- c) Locked in the storage facility

2. To find out what PPE is required for a specific pesticide application, where can it be found?

- a) Label
- b) Phonebook
- c) Dictionary
- d) none of these

3. _____ A REI or Re-entry Interval is?

- a) Time before you can enter a treated area
- b) Time before you can harvest the fruit in a treated area

True or False

4. _____ If you become ill while working with pesticides, stop working immediately. Notify your supervisor or a fellow employee that you are ill.

5._____ It is important to supply the physician or emergency room personnel with as much information as possible regarding the circumstances of a pesticide exposure. Also provide the physician with the name of the pesticide the victim was exposed to or handling. If possible, take a clean copy of the product label or MSDS to the physician with the victim.

6._____ Absorption of some chemicals is very rapid, while absorption of others is slow.

7._____ In case of emergency call 9-1-1, a physician, or the nearest poison control center.

8._____ Employers must post at the work site: the telephone number, the address and the physical location of a facility where emergency care is available.

Tractor and Sprayer Pre-Operation Checkpoints

Tractor checkpoints are similar to those on your car, and should be inspected daily or upon use. Remember the phrase GOT W? This phrase will help you remember the items to check before you start your day. "G" stands for gas or diesel, "O" is oil, "T" is tire pressure, "W" is water level in the radiator.

Sprayer Checkpoints

- Check all nozzles, strainers and orifices for obstructions.
- Look for leaks and worn spots on hoses.
- Check for leaks or obstructions in filters and strainers.
- Make sure valves operate freely with no leaks.
- Check for leaks on connections, application and agitation lines.
- Be sure pressure gauges operate freely. The gauges should come up to pressure and remain steady when the valve is open and return to zero when the valve is closed.

Airblast sprayers are the most common way to apply pesticides in a citrus grove. These pieces of

equipment always have numerous grease fittings. Add grease to all fittings before each use.

Clean, well functioning nozzles are important because they are responsible for delivering the pesticide to the target site. Clogged or worn nozzles are not in calibration and will not produce the proper pattern. It is important to allow your nozzle patterns to overlap by 30 % for best coverage , this overlap will vary with nozzles chosen and boom height where applicable.

Inside a strainer is a mesh screen that filters the fluid as it flows to the nozzle or back into the tank. Obstructions in these screens can cause the gauges to fluctuate. Strainers should always be checked before each application to maintain optimum coverage.

Pressure gauges should come up to pressure gradually and hold at the recommended pressure. Fluctuations indicate there may be a problem.

Mixing and Loading of Pesticides

Step One

Mixing, loading, transferring and application are the primary pesticide handling tasks. These tasks encompass the most hazardous aspects of a handler's job. Never attempt shortcuts where safety is concerned, and do not assume that every job will be the same. For example, even though you are familiar with a pesticide, take time to read the labeling every time you use the product as new and different information may have been added.

Pesticide handlers are most often exposed to harmful amounts of pesticides when mixing or loading concentrated pesticides. Handlers who mix and load concentrated pesticides with high toxicity levels are at a high risk of accidental poisoning. By observing some simple precautions, you can reduce the risks involved in this part of your job.

Select an Appropriate Area

Choose the pesticide mixing and loading area carefully. It should be outdoors or in a well-ventilated area away from people, animals, food, other pesticides, and other items that might be contaminated. Choose a place with good light,

especially if you are working at night. Be particularly careful not to mix or load pesticides indoors unless lighting and ventilation are adequate.

Protecting the Water Source

Always protect the water source while handling pesticides. Keep all fill hoses above the level of the pesticide mixture in the tank while filling. This prevents contamination of the hose and keeps pesticides from back-siphoning into the water source. If you are pumping water directly from the source into a mix tank, use a check valve, anti-siphoning device, or backflow prevention to prevent back-siphoning if the pump fails.

Avoid mixing or loading pesticides in areas where a spill, leak, or overflow would allow pesticides to enter water sources. Take special precautions where mixing situations require you to use water from a faucet, well, ditch, or pond.

Transferring Pesticides

While pouring any pesticide from its container, always keep the container and pesticide below face level. Pouring in this manner will avoid splashes, spills, and dusts from getting on your face or into your eyes and mouth. If there is wind outdoors or strong air currents indoors, stand downwind so the pesticide cannot blow back on you.

Handling Empty Pesticide Containers

Appearances can be deceiving. Although it appears that all the pesticide product has been removed from an empty container, it usually is not truly empty. The pesticide that clings to the inside of the container can be hazardous to you, other people, and the environment. The EPA mandates that any handler must immediately and properly dispose of empty containers.

If containers are rinsable, rinse them at least three times as soon as they are emptied. Be sure to always pour the rinsate back into a tank and never onto the ground. Return recyclable pesticide containers to the pesticide storage area or the container holding area until returned to the dealer. Do not leave them unattended at the mixing, loading, or

application site. Never give pesticide containers to children to play with or to adults to use.

How To Mix and Load Pesticides

How to Mix and Load Pesticides

1. Conduct pre-operation tractor/equipment check.
2. Choose a safe mixing location, with a safe water source.
3. Fill tank 1/3 full with water.
4. Start agitation in the tank.
5. Carefully measure all chemicals on a flat surface, below eye level. Be sure the measuring cup is precise enough for the measured units.

Examples:

- Don't use a 5-gallon bucket to measure 2 1/2-gallons of pesticide by filling it half full.
 - Don't use an aluminum drink can to measure 12 oz. This step is critical, so don't rush. Use the proper tools.
 - Follow all label instructions and recommendations because some chemicals are incompatible in a tank mix.
6. Slowly add chemicals to the tank. Don't forget the proper PPE and be careful to follow the mixing orders!

The word "W.A.L.E.S." will help you remember mixing orders for product solutions.

- Add water to the tank until 1/3 full
- **W**-Wettable Powders
- **A**-Agitation
- **L**-Liquids
- **E**-Emulsifiables
- **S**-Surfactants

Once measured, slowly add your chemicals while continuing to agitate spray solution the tank. Always be careful to prevent spills and overflows when filling the tank. Place cardboard round to soak up chemicals that miss the tank and would spill onto the ground.

When supplying water to the tank, remember to use a backflow prevention device. This can be a check valve, artesian pressure, or simply keeping a gap between fill hose and tank.

7. Remember always leave enough space for the liquid inside the tank to move. An overfilled tank can blow the lid off, allowing some of the tanks contents to spill onto the ground.

8. After properly sealing and storing the unused portion of the chemicals, you must wash the PPE that were used to mix and load since the application portion of the job often requires different PPE. Be sure to check the label one more time.

Container Management

If you have empty pesticide containers that cannot be refilled, reconditioned, recycled, or returned to the manufacturer, crush, break, or puncture them after they have been triple rinsed. This will make the containers unusable and may also save storage space. Dispose of containers in accordance with label directions and with federal, state, and local laws and regulations.

Rinsing Containers

All containers under 28 gallons must be rinsed at the time of use, unless they are returned to the registrant or if the pesticide is not diluted during use.

There are two rinsing procedures that require the following steps:

Rinsing Procedure #1:

1. For containers smaller than 5 gallons, use enough water to fill the container 1/2 full. For larger containers, use enough water to fill them one fifth full.
2. After putting the appropriate amount of water into the container, close the container securely and agitate.

3. Drain the solution into the mix tank. Allow the container to empty completely.

4. Repeat steps 1 - 3 a minimum of 3 or more times.

Procedure #2:

1. Turn the empty container over and place the opening over the opening of the tank. Insert jet rinse nozzle, this container opening must be located in the opening of the mix tank so the liquid will drain into the tank. The jet rinse nozzle must be able to rinse all inner surfaces of the container.
2. Turn the nozzle on and rinse until the water coming from the container is clear. Use a minimum of 1/2 the container volume of water.

WPS Posting

As soon as you finish mixing, loading, or applying a pesticide, you should do a few important follow-up tasks. Take the time to clean up properly. Wash all pesticide equipment and then wash yourself. Return all equipment to its designated place and safely store or dispose of all pesticide materials and other chemicals. Be sure that the work site presents no hazards to people or the environment. Never leave the site unattended until everything has been cleaned up and put away properly. Record what you have applied and the conditions at the application site.

Record-Keeping

Documentation or keeping records of pesticide use and application is mandatory and can provide proof of proper use. If an error has been made, records are helpful in finding the cause. Records or documentation can provide credibility in cases involving claims of excess residues or damages.

Good records can save money. They allow you to compare the results obtained from using different pesticides, different formulations, different equipment and for applications under various site conditions. You can improve your pest-control practices and your efficiency by reviewing field results with spray records..

Records can help you reduce pesticide mistakes or misuse. If a pest is not controlled, if damage has occurred in the target area, or if a pesticide has moved off the target area and caused problems, you may be able to determine what went wrong. Records may help you to determine that a particular pesticide, a particular formulation, type of application equipment, or some condition in the treatment area that caused the problem. Then you can take steps to avoid such a situation in future pesticide applications.

Good records can help you better determine the exact amount of pesticide you'll need. Some pesticides do not store well for long periods of time, and disposal of excess pesticide can be expensive.

Required Record Information:

- Names of any handlers and applicators involved in the activity.
- Time of day and date of application.
- Location and description of treated area, including climatic conditions at the site.
- Pesticide used -- brand name, common name, formulation type, percentage of active ingredient, and EPA registration number.
- Amount of formulation used (and amount of diluents or other adjuvant added, if any).
- Total amount of pesticide applied and the rate of application.
- Size of treated area (acres).

Proper Calibration

Applying the Correct Amount

One of the most important tasks for a pesticide applicator is making sure that the correct amount of pesticide is being applied to the target site. Applying either too little or too much pesticide can cause problems.

For each pesticide application, take the time to calibrate correctly. Be sure to recheck the applied amount during the application.

Underdosing is expensive. If you apply too little pesticide, you may not fully control the pest. Sometimes this can cause you to have to redo the entire application. This can be very costly in both time and money. In other cases, a repeat application may not be possible because it would result in an overdose.

Overdosing is expensive because of the high cost of pesticides and possibility of environmental contamination. Do not use any more than the amounts listed in the directions for use on the pesticide label.

Calibrating Your Equipment

Proper pesticide applications involve equipment that must be measured and adjusted (calibrated) to release the correct amount of pesticide to the target site. Proper calibration is an essential, but often neglected task. To be sure your equipment is applying the right amount of pesticide, take time to calibrate it carefully and correctly. Recheck the equipment regularly to detect changes caused by wear, corrosion, and aging of nozzles, pumps and other parts.

Calibration often requires some simple arithmetic. Usually the equipment manufacturer, the pesticide dealer, your industry organization, or the Cooperative Extension Service will provide some standard formulas to help you. Choose equipment that you know how to use and that is: designed for the type of chemical being applied, and appropriate for the size and type of application job.

With a full tank of pesticide mixed, you are ready to start making your application. While traveling from the mixing location back into the grove, use extreme care. Loaded tanks can weigh in excess of 10,000 pounds. On numerous occasions, tractors have been pushed out into intersections or into ditches because the operator underestimated their stopping distance.

Nozzle Arrangement

The nozzles should deliver a uniform distribution of the spray products over the tree. Uniform distribution throughout the trees has been shown to result in better control than previous recommendations of 2/3 of the product in the top half of the tree.

Application Best Management Practices

Best management practices really come into play during your application. Nozzles should always be turned off before a sprayer exits a row end. Never leave the nozzles on when turning. Pesticides can drift directly into water sources such as canals and ditches.

The end trees in each row should be sprayed in a technique called wrapping, the process of driving around the perimeter of the block and using only the nozzles on one side of the sprayer to apply materials to the end trees. Similar techniques can be used when spraying in blocks with lots of resets or dead trees. If there are no trees to spray, turn the nozzles off you will be saving material, and require fewer tanks to cover the block.

Some sprayers are outfitted with devices that allow them to turn nozzles on and off automatically. Smart sprayers, as they are called, can offer huge savings in time, money and material. Sprayers without tree sensing technology apply a constant amount of material regardless of tree size. This often results in excess application of materials to resets, missing trees, and smaller trees.

Mix/Load and Application Quiz

Multiple Choice

1. _____ Circle the letter that applies when rinsing a pesticide container?
 - a) For containers smaller than 5 gallons, use enough water to fill the container 1/4 full. For larger containers, use enough water to fill it one fifth full.
 - b) Put the appropriate amount of water into the container. Close the container securely and agitate.
 - c) Drain the solution into the mix tank. Allow the container to empty completely.
 - d) Repeat steps 1 - 3 a minimum or 3 more times.

e) All of the above

2. _____ How can an applicator prevent pesticides from back siphoning into their water source?

- a) Foot valve or check valve
- b) Gap between fill hose and tank
- c) Both

3. _____ Pesticides should be measured where?

- a) On a flat surface
- b) Below eye level
- c) a and b

True or False

4. _____ It's okay to take home any leftover pesticide used at work and use them around your home.

5. _____ Pesticides and fertilizers might react chemically and result in a fire. If pesticides contaminate fertilizers, there also exists the possibility of crop damage or residues on produce sent to market.

6. _____ Post warning signs on all storage areas containing pesticides (or empty containers) with the signal words "DANGER" or "WARNING" on the label. Post signs on all directions of possible approach. You must be able to read sign from 25 feet away.

7. _____ You can transport pesticides in the same compartment with a person, food, or animal feed.

8. _____ You can bury pesticide containers for disposal.

References

Cornell University, The Pesticide Management Education Program, Pesticide Applicator Core Tutorial, h

<http://pmep.cce.cornell.edu/facts-slides-self/core-tutorial/>

U.S. Environmental Protection Agency, Worker Safety and Training,
<http://www.epa.gov/pesticides/health/worker.htm>

U.S. Environmental Protection Agency,
Pesticides: Health and Safety,
h
<http://www.epa.gov/oppfead1/safety/workers/trainreq.htm>

University of Florida / Institute of Food and Agricultural Sciences,
<http://edis.ifas.ufl.edu/pdf/CV/CV10800.pdf>

University of Missouri, Pesticide Application Safety,
<http://muextension.missouri.edu/explore/agguides/agengin/g01916.htm>

Additional readings

The following publications that provide information for citrus grove workers are available through EDIS, the UF/IFAS on-line document system.

English

First Aid, Heat Stress, and Safety for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE242>

Understanding the Pesticide Label for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE243>

Personal Protection Equipment for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE244>

Equipment Safety for Citrus Grove Workers, <http://edis.ifas.ufl.edu/AE245>

Herbicide Application Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE246>

Pesticide Application Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE247>

Fertilizer Application Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE248>

Aquatic Vegetation Management Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE249>

Drainage Management Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE250>

Irrigation Management Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE251>

Riser Board Water Control Structures Best Management Practices for the Citrus Grove Worker, <http://edis.ifas.ufl.edu/AE252>

Best Management Practices for Agricultural Maintenance Facilities, <http://edis.ifas.ufl.edu/AE253>

Spanish

Primeros Auxilios, Insolación y Seguridad para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE270>

Entendiendo la Etiqueta del Pesticida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE271>

Equipo de Protección Personal para los trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE272>

Seguridad con el Equipo para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE273>

Mejores Prácticas de Manejo en Aplicaciones de Herbicida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE274>

Mejores Prácticas de Manejo en Aplicaciones de Pesticida para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE281>

Mejores Prácticas de Manejo en Aplicaciones de Fertilizante para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE275>

Mejores Prácticas de Manejo en Aplicaciones de Malezas Acuáticas para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE276>

Mejores Prácticas de Manejo con Drenaje para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE277>

Mejores Prácticas de Manejo con Irrigación para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE278>

Mejores Prácticas de Manejo con compuertas de retención de agua para los Trabajadores de Cítrico, <http://edis.ifas.ufl.edu/AE279>

Mejores Prácticas de Manejo para el Mantenimiento en Facilidades Agrícolas, <http://edis.ifas.ufl.edu/AE280>

Question Number	Correct Answer
1	c
2	a
3	d
4	Caution Warning Danger
5	True
6	True
7	True

First Aid and WPS Quiz.

Question Number	Correct Answer
1	c
2	a
3	a
4	True
5	True
6	True
7	True
8	True

Mix/Load and Application Quiz.

Question Number	Correct Answer
1	e
2	c
3	c

Mix/Load and Application Quiz.

4	False
5	True
6	True
7	False
8	False