How pesticides may affect the environment

By Laurie Ann Hurner

This CEU article grants one General Standards (Core) CEU when submitted and approved toward the renewal of a Florida Department of Agriculture and Consumer Services restricted-use pesticide license.

Farmers face more pressure than ever before regarding pesticides and their use. More often, articles and news programs are highlighting the effects pesticides are having on the environment. This is a change in focus from years past, when worker safety was the main emphasis. Hazards to humans were the main reason that the Environmental Protection Agency (EPA) began classifying pesticides as general and restricted-use. In addition to human protections, most restricted-use pesticides list on the label environmental concerns such as toxicity to birds, contamination to ground water, etc. The EPA requires extensive testing on protections needed for humans and the environment before it will ever register a pesticide for use.

What exactly is the meaning of environment? According to Merriam-Webster Dictionary, environment means "the complex of physical, chemical, and biotic factors (as climate, soil and living things) that act upon an organism or an ecological community and ultimately determine its form and survival." So, the environment includes all things around us, not just the natural ones. An important thing to remember is that the environment does not just include the outdoors, but the indoors as well. A pesticide applicator must consider the air, soil, water, plants, animals, humans and so on before making a pesticide application. According to the University of Florida/Institute of Food and Agricultural Sciences (UF/IFAS) Extension pesticide manual "Applying Pesticides Correctly" by Frederick M. Fishel, "The user must ask two questions:

1. Where is the pesticide going to go in the environment after it leaves its container or application equipment?
2. What effects can the pesticide have on those non-target sites it may reach in the environment?"

CONTAMINATION SOURCES

There are basically two sources of contamination of the environment: point-source pollution and non-point-source pollution. Let's take a closer look at both.

Point-source pollution comes from a specific, identifiable place, point or individual. A pesticide that flows directly into a storm drain or off-site body of water is an example.

Non-point-source pollution comes from a wide area. Movement of pesticide residues into a local river is an example. Non-point-source pollution from pesticide applications is most commonly blamed for contaminating the environment.

According to Fishel, "Contamination also results from point sources, such as:

- Wash water and spills produced at equipment cleanup sites
- Improper disposal of containers and water from rinsing containers
- Pesticide storage sites where leaks and spills are not correctly cleaned up
- Spills that occur while mixing concentrates or loading pesticides into application equipment"

These activities occur every day, and accidents do happen. Pesticide applicators need to be reminded frequently that any time they deal with pesticides, they need to be extra careful and aware of their surroundings.

PESTICIDE CHARACTERISTICS

How do pesticides move in the environment? In order to answer that question, the applicator needs to understand the physical and chemical characteristics of pesticides and how to determine a pesticide's interaction with the environment. Fishel does a great job of outlining these characteristics:

- **Solubility** is a measure of the ability of a pesticide to dissolve in a solvent — usually water. If a pesticide is highly soluble in water, it dissolves very easily. Since these pesticides dissolve easily, they are more likely to move with water in surface runoff or by movement through the soil water.
- **Adsorption** is the process in which a pesticide binds to soil particles. Adsorption occurs because of an attraction between the chemical and soil particles. Typically, oil-soluble pesticides are more attracted to clay particles and organic matter in the soil than water-soluble pesticides. In addition, pesticide molecules with positive charges are more tightly adsorbed to negatively charged soil particles.
- **Persistence** is the ability of a pesticide to remain present and active in its original form for an extended period of time before breaking down. A chemical's persistence is described in terms of its half-life (a comparative measure of the time needed for the chemical to break down). The longer the half-life, the more persistent the chemical. From a farmer's perspective, long half-life products are a good thing. They do not have to be applied as often, and they provide long-term pest control. From an environmental standpoint, long half-life products are a real problem. These products can stay in or on the surface (e.g., plants, fence posts and soil) and later cause problems for plants, animals and humans. Persistent pesticides may also cause problems by showing up in harvested products in the form of residues. Applicators

should always check the label for statements about the persistence of the pesticide, especially for replanting restrictions.
- **Volatility** is the tendency of a pesticide to turn into a gas or vapor. The chance of volatization increases as temperature and wind increases. The potential for a pesticide to volatize is measured by its vapor pressure. Pesticides with high vapor-pressure values are more volatile. These pesticides can easily move off-site and affect non-labeled plants and applicators.

PESTICIDE MOVEMENT

Now that we have discussed the characteristics of pesticides, let's talk about how they move in the environment. Generally, pesticides move in water, in air, attached to soil particles and on/in objects.

Pesticides can move away from the application site in a variety of ways. If pesticides are on/in objects that move, they will move as well. If pesticide applicators bring home clothing or personal protective equipment that has been contaminated, pesticide residue can be transferred to household surfaces, family members and pets. Remember that pesticide residue remains on treated crops, feed products and livestock. Acceptable levels of pesticide residues are known as their tolerance. Every pesticide applicator should be familiar with the residue tolerance levels of the pesticides they are using.

Airborne movement of pesticides to non-target areas is called drift. Off-target movement can come in the form of spray droplet drift, vapor drift or particle (dust) drift. According to Fishel, "Where significant drift does occur, it can damage or contaminate sensitive crops, poison bees, pose health risks to humans and animals, and contaminate soil and water in adjacent areas." In the state of Florida, pesticide applicators have a legal responsibility to avoid drift.

There are three different types of drift that occur. Spray drift is the off-target movement of a pesticide during a liquid application. Vapor drift refers to the movement of pesticides as gaseous vapors from the target area. Vapor drift most often occurs during high temperatures where pesticides that are volatile can change from a solid into a liquid form into a gas under certain conditions. Particle drift, the third type of drift, refers to the movement of solid particles from the target area by the air during or just after an application. These types of drift may be a result of pesticides formulated as dust or soil particles to which pesticides have attached. Spray drift is the most common type of drift reported. According to studies, most drift is caused by applicator error.

If drift is so much of a problem, how can it be avoided? Drift can be controlled by maximizing droplet size and minimizing the time that the droplets are in the air. "Applying Pesticides Correctly" makes the following recommendations:
- Make applications in accordance with label directions.
- Keep in mind Florida law regarding organoauxin herbicides.
- Spray only when conditions are right.
- Select boom configuration for maximum performance.
- Select a reasonable application speed.
- Select the best nozzle and size for each type of application and use drift-reduction nozzles.
- Calibrate the sprayer and replace worn nozzles.
- Use higher carrier rates.
- Use low-volatile formulations.
- Use drift-reduction agents.

PREVENTING WATER CONTAMINATION

Pesticide contamination of water is also a problem. Surface water is drinking water in some areas of the state. So, pesticide contamination of surface water can quickly become a human health hazard. Runoff into surface water becomes a problem for some outdoor pesticide application sites. Pesticides that move in runoff water can contaminate plants and animals located downslope and may reach sources of surface water.

Consider the total environment — including air, soil, water, plants, animals and humans — before making a pesticide application.

Groundwater contamination can also become a problem. According to Fishel, "Groundwater provides 62 percent of Florida's water withdrawals and is the drinking water source for approximately 90 percent of its citizens." Once groundwater is contaminated, it is almost impossible to correct the problem. Many people, including pesticide applicators, do not make the connection between groundwater and drinking water since groundwater is generally not seen with the naked eye. It is below the earth's surface in cracks in the bedrock and in the spaces between soil particles. This water is the source for wells and springs.

Preventing surface and groundwater contamination is a lot easier than trying to clean up a water source once it is contaminated. The main goal is to keep the pesticide out of the water resources. If the pesticide applicator creates a mental checklist of the following, the chances of contaminating the water source are greatly reduced:
- ✓ Consider the vulnerability of the application site.
- ✓ Follow the pesticide label.
- ✓ Evaluate the location of the water sources.
- ✓ Consider weather and irrigation.
- ✓ Measure pesticides carefully.
- ✓ Mix and load carefully.
- ✓ Store pesticides safely.
- ✓ Dispose of waste carefully.

EVERYTHING ELSE

There is one last section of the environment that pesticide applicators and others need to be cautious of. I like to refer to this section as "everything else." Sensitive areas, non-target organisms and endangered species can become a target of poor pesticide application. These are areas that applicators probably do not think about or take into consideration when making a pesticide application. Schools, bees, fish, non-target plants and animals, and plants on the endangered species list need to be considered long before making the pesticide application. They must be protected at all costs.

It may seem like an exhausting job to keep in mind all the parts of the environment that need to be considered when applying pesticides. It is really not hard to keep all of these things safe. Simply read the label, consider your surroundings and know exactly what to do should a problem arise. If the applicator uses the right pesticide at the correct rate, at the right time with the proper application technique, drift and runoff can be avoided and the environment protected. If you have questions or need further information regarding pesticides in the environment, pick up a copy of "Applying Pesticides Correctly" or contact your local UF/IFAS Extension office and ask to speak to an agriculture agent.

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Mail the answer sheet or a copy of the form to:

Laurie Ann Hurner
UF/IFAS Extension Highlands County, 4509 West George Blvd.
Sebring, FL 33875

If you have questions regarding this form, test or CEUs, e-mail Laurie Ann Hurner at lhurner@ufl.edu or call 863-402-7150. Please allow two weeks to process your CEU request.

'How pesticides may affect the environment' test

To receive one Core continuing education unit (CEU), read "How pesticides may affect the environment" in this issue of *Citrus Industry* magazine. Answer the 20 questions on the magazine's website (www.citrusindustry.net) or mail the answers and application information to the address at the bottom of the page. The article and test set are valid for up to one year from the publication date. After one year, this test will no longer grant a CEU.

1. Point-source pollution is the hardest type of pollution to blame on someone because you do not know where it came from. T F
2. The environment includes indoor and outdoor areas. T F
3. A pesticide applicator must consider which of the following environmental factors before making a pesticide application?
   a. The price of fuel
   b. The last application made
   c. The air, soil and water
   d. None of these
4. From this point going forward, the EPA's main emphasis involving pesticide applications is human safety. T F
5. Vapor drift is the most common type of drift reported, and according to studies, most drift is caused by applicator error. T F
6. Surface water contamination is never a problem when applying agricultural pesticides. T F
7. Point-source pollution comes from a specific, identifiable place or point. T F
8. There are basically two sources of contamination in the environment: point-source and multi-source. T F
9. Non-point-source pollution can result in fines for all agricultural land along a river if it becomes contaminated, because it is hard to pinpoint where it came from. T F
10. The best way to prevent contaminating water sources is to not apply pesticides near any water bodies. T F
11. Endangered species can become victims of point-source pollution. T F
12. Drift can be controlled by minimizing droplet size and maximizing the time that the droplets are in the air. T F
13. Surface water is never used for drinking water in the United States. T F
14. Birds, bees, sensitive areas and off-target pests are all vulnerable to pesticide contamination. T F
15. Solubility means
   a. Ability of the pesticide to remain present and active in its original form for an extended period of time
   b. The tendency of a pesticide to turn into a gas or vapor
   c. The ability of a pesticide to dissolve in solvent
   d. All of the above
16. Pesticides move in the environment only through the air. T F
17. Pesticides never move away from an application site on moving objects. T F
18. Acceptable levels of pesticide residue are called
   a. Their maximum level
   b. Their minimum level
   c. Their left-over level
   d. Their tolerance level
19. Airborne movement of pesticides is called runoff. T F
20. The longer the half-life of a pesticide, the more persistent it is. T F

Please circle the number below to rate this article and test:

Not very useful	1	2	3	4	5	6	7	8	9	10	Very useful

Pesticide Applicator CEU Form

First Name:_____ **Last Name:**_____

E-mail: _____

Pesticide License Number: _____

Address: _____

City: _____ **Street:** _____ **Zip:**_____

Phone: _____