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Pesticides can enter the aquifer through water wells.

Protecting soil and water while using pesticides

By Laurie A. Hurner

Editor's note: This article grants one continuing education unit (CEU) in the Core category toward the renewal of a Florida Department of Agriculture and Consumer Services restricted-use pesticide license when the accompanying test is submitted and approved.

Pesticides, pesticides, pesticides. It seems that the word pesticide has become quite negative. We hear it every day in mainstream media: There are pesticides in our food. There are pesticides in the air. There are pesticides in the water. So, the question is often asked: Can you use pesticides and protect the environment? The answer to this question is undeniably yes!

Proper selection, use and disposal of pesticides are all ways to protect the environment. This article will look at two very important parts of our environment — soil and water — and their interaction with pesticides.

Soil health is very important to agriculture. Growers who have a good handle on their soil type and the ways that it will support their plants may have half of the agriculture picture figured out. It is also important to consider the soil when selecting and applying pesticides.

There are several soil factors to consider when making pesticide applications: pesticide adsorption, pesticide transfer, volatilization, runoff, leaching, absorption (uptake), crop removal and pesticide degradation. Let's look at each of these factors.

PESTICIDE ADSORPTION

Adsorption is the process in which pesticides will bind to soil particles. It can be thought of like a magnet's attraction to a refrigerator. There are negative and positive charges that attract each other. The positively charged pesticide particles will be drawn to the negatively charged soil particles. Some soil types have stronger attraction qualities than others. A highly organic soil will be more adsorptive than a sandy soil.

You might think that the more adsorptive a soil, the better it is. However, if the pesticide is attached too tightly to the soil particle it cannot be easily drawn up by the pest (a weed, in this case). Therefore, to enhance pest control, make sure the soil is sufficiently moist so the pesticide will be freely available within the soil layer to be picked up by the pest.

PESTICIDE TRANSFER

Pesticide transfer in the soil is necessary to make the pesticide work. The pesticide must be taken up by the plant/pest or the plant seeds in the soil. However, too much pesticide transfer can certainly be a negative thing. There are six ways that pesticide can move in or on the soil:

Volatilization is the conversion of a solid or a liquid to a gas. This can be a very dangerous and expensive conversion. The environmental conditions surrounding a pesticide application can increase volatilization. High temperatures, low relative humidity and air movement all increase volatilization. These factors must be monitored prior to pesticide application and for the following day as well. Volatile pesticides become less effective for pest populations when applied in the wrong conditions, and they may even injure nontarget species.

Runoff is the second way a pesticide can be transferred. According to Merriam-Webster, runoff is the portion of precipitation on land that ultimately reaches streams, often with dissolved or suspended material. Runoff occurs when water is applied at a faster rate than it can enter the soil.

Before applying pesticides, make sure that runoff can be avoided. Try not to make an application soon after a heavy rain. Avoid overirrigating soon after a pesticide application. Use a spray tank additive to hold the pesticide to the leaf surface longer or by incorporating soil-applied pesticide.

Leaching is the movement of pesticides through the soil rather than over the surface. A pesticide held tightly to the soil particles by adsorption is less likely to leach. Soil factors that influence leaching include texture and organic matter content. How readily water moves through a soil is also a factor in leaching. A sandy soil is much more permeable than a clay soil. This is very apparent on the Central Florida Ridge.

Closely monitor rainfall forecasts and do not schedule irrigation following a pesticide application. One of the biggest issues to remember with leaching is that pesticides can potentially leach through the soil into the groundwater from mixing, loading, applying and cleaning pesticide

equipment. Applicators need to be very careful with water movement over and into the soil.

Absorption (uptake) is the movement of the pesticide into the plant or the animal. This is the goal of the pesticide application. A pesticide applicator's goal should be to have soil, air and water conditions as near to perfect as possible for a pesticide application and subsequent absorption.

Crop removal moves the pesticide that has been applied away from the application site. Many applicators fail to recognize that not only are they transferring the pesticide when they pick the vegetables or cut the sod, they are also transferring the pesticide when they cut down shrubs and trees and remove the plant material.

Pesticide degradation is the last way to transfer pesticides. Pesticide degradation is the process by which pesticides break down and is usually beneficial. For the most part, as pesticides break down, they become nontoxic and harmless. Pesticide degradation is detrimental when soil conditions are such that the pesticide breaks down prior to being absorbed by the plant material or the pest being destroyed.

PESTICIDES AND WATER QUALITY

Another potential fate of pesticides in the environment is water. The two types of water that are affected by pesticides are groundwater and surface water. Contamination can come from many potential sources, including but not limited to industrial and municipal waste, underground fuel tanks, road salts, malfunctioning septic tank systems and even agriculture and residential fertilizers.

The groundwater system runs just below the soil surface and fills the pore spaces in and around rock, gravel, sand and other materials. There are pockets under the soil surface referred to as aquifers. At the top of the aquifer is the water table. The water table in any area can fluctuate as more water enters the groundwater system from rainfall. Even though water flows slowly through the layers of the water system to get to the aquifer, pesticides and other contaminants can be found in the aquifer.

One thing that helps protect the aquifer from contamination is the

Image credit: Bundit Minamun, Dreamstime.com

Pesticide applicators must take measures to protect surface water systems.

depth of the water table. The further the water table is from the surface of the soil, the better. Pesticides can flow below the root zone and into the aquifer and can also enter the aquifer through water wells. Wells for drinking and for agriculture irrigation can easily be contaminated because a well is a direct conduit to the aquifer that is drilled from the soil surface. Pesticides can reach groundwater along the outside of a well casing, by entering a well that has not been capped properly, and from pesticide mixing and loading sites, pesticide disposal sites, and equipment cleaning and storage sites.

Surface water is stored or flows along the earth's surface. Canals, lakes, rivers and drainage ditches are all surface water systems that pesticides could potentially affect. The quantity and quality of surface water is very important and should be protected at all costs. Surface water eventually enters the soil profile, enters the groundwater systems or flows into the oceans.

There are several ways to protect water sources. It is much easier to prevent water contamination than it is to clean it up. Cleanup can be very expensive and take many years. The following are some best management practices that should be followed to protect the water sources:

- Practice integrated pest management.
- Select pesticides carefully.
- Consider the vulnerability of the area.
- Measure accurately.
- Calibrate accurately.
- Mix and load carefully.
- Prevent back-siphoning.
- Consider weather and irrigation.
- Store pesticides safely.

- Dispose of wastes carefully.
- Never dispose of pesticides or pesticide containers near a water source, even shallow water tables, in sinkholes or in abandoned wells.
- Prevent spills.
- Leave buffer zones around sensitive areas.

So, let's circle back around and answer the question: How can I help save the environment with pesticide usage? It is every pesticide applicator's responsibility to save the environment. Applicators perform activities every day to save the environment without even thinking about it. The activities suggested above, protecting the soil and water environments, are all a part of daily activities. They are not extra, special or difficult things to accomplish.

With profit margins continually narrowing with the ongoing fight against citrus greening, saving the environment is not only a best management practice but also a smart monetary practice. Without good soil and clean water, we will not be able to produce citrus in Florida.

The next time you read or hear someone say that farmers are the real problem and are the ones contaminating the world's water and soil, speak up and let them know what the citrus industry is doing to protect the environment.

Source: Pesticides and the Environment by Fred Fishel, University of Missouri Extension, https://extension2.missouri.edu/g7520

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