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MANAGING PESTICIDES ON CHRISTMAS TREES TO AVOID CONTAMINATING WATER

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How Pesticides Reach Surface and Groundwater

Lakes, rivers, streams and other surface water are a critical resource for everyone. Groundwater is used by many people in Michigan for household and other water supplies. By taking steps to keep pesticides out of groundwater, you are protecting this valuable resource. There are several processes that determine the fate of pesticides and whether they will end up in groundwater.

- **Adsorption** is the binding of chemicals to soil particles. The amount and persistence of pesticide adsorption varies with pesticide properties, soil moisture content, soil pH, and soil texture. Soils high in organic matter or clay are the most adsorptive; coarse, sandy soils are much less adsorptive. A soil-adsorbed pesticide is less likely to volatilize, leach or be degraded by microorganisms but is also less available for intake by plants.

- **Volatilization** occurs when a solid or liquid turns into a gas. Volatilization of pesticides increases with higher air temperature and air movement, higher temperature at the treated surface (soil, plant, etc.), low relative humidity, and when spray droplets are small. Pesticides also volatilize more readily from coarse-textured soils and from medium- to fine- textured soils with high moisture content. A pesticide in a gaseous state can be invisible and carried away from a treated area by air currents.

- **Runoff** is the movement of pesticides in water across the soil surface. It occurs as water moves over a sloping surface, carrying pesticides either mixed in the water or bound to eroding soil. The amount of pesticide runoff depends on the grade or slope of an area, the erodibility and texture of the soil, the soil moisture content, the amount and timing of irrigation or rainfall, and properties of the pesticide.

- **Leaching** also moves pesticides in water. In contrast to runoff, leaching occurs as water moves downward through the soil. Factors that influence leaching include whether the pesticide dissolves easily in water, soil structure and texture, the amount and timing of irrigation or rainfall, and the amount and persistence of pesticide adsorption to soil particles.

- **Absorption** is the process by which chemicals are taken up by plants. Once absorbed, most pesticides are degraded within plants. However, these residues may persist inside the plant and be released back into the environment as the plant tissues decay.

- **Crop removal** can transfer pesticides. When treated crops are harvested, the pesticide residues are removed with them and transferred to a new location.

- **Microbial degradation** occurs when microorganisms such as fungi and bacteria use a pesticide as a food source. Conditions thatfavor microbial growth include warm temperatures, favorable pH levels, adequate soil moisture, aeration (oxygen), and fertility. Adsorbed pesticides are more slowly degraded because they are less available to some microorganisms.

- **Chemical degradation** is the breakdown of a pesticide by processes not involving a living organism. The adsorption of pesticides to the soil, soil pH levels, soil temperature and moisture all influence the rate and type of chemical reactions that occur. Many pesticides, especially the organophosphate insecticides, are susceptible to degradation by hydrolysis in high pH (alkaline) soils or spray mixes.

- **Photodegradation** is the breakdown of pesticides by sunlight.

To learn how to protect groundwater when applying pesticides, some basic information on groundwater is helpful. **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). It is stored in underground rock or soil formations known as **aquifers**. Groundwater moves through aquifers and can be obtained at points of natural discharge such as springs or streams, or by drilling a well into the aquifer.

- The upper level of the saturated zone in the ground is called the **water table**. The water table depth below the soil surface fluctuates throughout the year, depending on the amount of water removed from the ground and the amount of water added by recharge and connected surface waters. **Recharge** is water that seeps through the soil from rain, melting snow, or irrigation. **Surface waters** are visible bodies of water such as lakes, rivers, and oceans.

Both surface water and groundwater are subject to contamination by **nonpoint source pollution**. This type of pollution generally results from land runoff, precipitation, acid rain, or percolation rather than from a discharge at a specific, single location (such as a single pipe or well head). Contamination from these single sites is known as **point source pollution**.

Keeping Pesticides Out of Surface and Groundwater

A pesticide that is not volatilized, absorbed by plants, bound to soil, or broken down can potentially move through the soil to groundwater. The movement of groundwater is often slow and difficult to predict. Substances that enter the 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 recognizable. The problem is occurring underground, out of sight.

It is very difficult to clean contaminated surface or groundwater. The best solution is to prevent contamination in the first place. The following pesticide applicator practices can reduce the potential for surface and groundwater contamination.

- **Use integrated pest management programs**—Minimize pesticide use by combining chemical control with other pest management practices.

- **Consider the geology of your area**—Be aware of the water table depth and the permeability of the geological layers between the surface soil and groundwater. Sinkholes can be especially troublesome because they allow surface water to quickly reachgroundwater.

- **Consider soil characteristics**—Determine the susceptibility of the soil to leaching.

- **Select pesticides carefully**—Pesticides that are highly soluble, relatively stable, and not readily adsorbed to soil tend to be the most likely to leach. Read labels carefully and consult a specialist from a cooperative extension office, or your chemical dealer if necessary. The table in this bulletin will also help you determine the best pesticides for your use.

- **Follow label directions**—The label carries crucial information about the proper rate, timing, and placement of the pesticide.

- **Calibrate accurately**—Equipment should be calibrated carefully and often to avoid over or under application.

- **Measure accurately**—Concentrates need to be carefully measured 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.

- **Consider weather and irrigation**—If you suspect heavy rain will occur, delay applying pesticides. Control the quantity of irrigation to minimize potential pesticide leaching and runoff. Remember that wind speed at the time of any application should be 5 to 8 mph or less.

- **Avoid spills**—But when they do occur, contain and clean them up quickly with an absorbent material like cat litter.

- **Change the location of mixing areas**—Mix and load pesticides on an impervious pad if possible. If mixing is done in the field, change the location of the mixing area regularly.

- **Dispose of wastes properly**—Obey laws regulating the disposal of pesticide wastes. Triple rinse containers. Pour the rinsewater into the spray tank for use in treating the site or the crop.

- **Store and mix pesticides away from water sources such as wells, pond, and springs.**

Selecting Pesticides

When selecting pesticides for use on Christmas trees, consider soil and site information along with pesticide characteristics to assess the potential risk of pesticide use on water quality. The table included in this publication lists common pesticides and their potential for leaching and runoff. If the site has a high potential for surface runoff or leaching, choose a pesticide that has a low potential for runoff or leaching or use a non-chemical method for pest control.

Common Christmas Tree Pesticides Potential for Leaching and Runoff

The following table lists the potential for leaching and runoff for some common pesticides used on Christmas trees. *The listing ofthese products does not imply endorsement by the cooperative Extension Service or bias against those not mentioned.*

Trade Name	Common Name	Potential for Leaching	Potential for Runoff
Herbicides			
2,4-D Amine	2,4-D	low	medium
Atrazine	atrazine	high	medium
Asulox	asulam	medium	low
Banvel	dicamba	high	low
Casoron	dichlobenil	high	medium
Chipco Ronstar G	oxadiazon	*	*
Fusilade 2000	fluazifop-butyl	low	high
Goal	oxyfluorfen	low	high
Kerb	pronamide	low	high
Krenite	fosamine	low	medium
Paraquat	paraquat	low	high
Poast	sethoxydim	low	low
Princep	simazine	high	medium
Roundup	glyphosate	low	high
Surflan	oryzalin	low	medium
Tordon	picloram	high	low
Velpar	hexazinone	low	high
Insecticides			
Sevin	carbaryl	low	medium
Fungicides			
Bayleton	triadimefon	medium	medium
Bravo	chlorothalonil	low	high
Dithane	mancozeb	low	high
Manzate 200	mancozeb	low	high

*Not listed in ARS/SCS pesticide properties database.

These leaching/runoff potential ratings are from the ARS/SCS pesticide properties database and were developed for use with the SCS soils ratings for water quality in the SCS "Soil-Pesticide Interaction Ratings."

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