The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
- It is not a regulatory agency, but it does inform people of regulations and of their options in meeting them.
- Local programs are developed and carried out in full recognition of national problems and goals.
- The Extension staff educates people through personal contacts, meetings, demonstrations, and the mass media.
- Extension has the built-in flexibility to adjust its programs and subject matter to meet new needs. Activities shift from year to year as citizen groups and Extension workers close to the problems advise changes.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, the Director of Cooperative Extension Service, Oklahoma State University, Stillwater, Oklahoma. This publication is printed and issued by Oklahoma State University as authorized by the Vice President, Dean, and Director of the Division of Agricultural Sciences and Natural Resources and has been prepared and distributed at a cost of 42 cents per copy. 0313 Revised GH

Pesticides in Residential Areas—Protecting the Environment

Brad Kard
Extension Pesticide Coordinator

Kevin Shelton
Extension Coordinator

Charles Luper
Extension Associate

Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

This fact sheet presents factors that affect pesticide loss to the aquatic environment, discusses toxicity of pesticides, and offers advice for reducing the environmental impact of the pesticides used in residential areas.

A well-maintained, healthy lawn and lush ornamentals increase property values, help prevent erosion, conserve water, deaden sound, supply oxygen, and increase aesthetic and recreational values. But landscaping requires intensive care, such as watering, fertilizing, mowing, and pest control. Protecting the environment also requires care because some pesticides, specifically insecticides, herbicides, and fungicides, may be washed from lawn areas to surface and ground waters.

Public concern generally focuses on the use of pesticides and fertilizers on large tracts of agricultural land. But, for the urban and suburban environment, residential use may be a greater concern. Pesticides, fertilizers, and other active materials are used extensively in the urban, suburban, and residential environment. Studies have shown that, after a heavy summer rain, nitrates and pesticides increase dramatically in streams and lakes near areas of urban or suburban development.

Use of pesticides and fertilizers in residential areas is very different from agricultural uses. In residential areas, chemicals are applied to smaller areas, but applications may be heavier and more frequent. Some lawns, for example, receive 10 or more pesticide applications per season, and two or three times as much nitrogen as a typical field crop.

Pesticide Movement

Pesticides are designed to stay in place to control the target pest, then degrade into harmless products. However, some pesticides can move from the site of application to the surrounding area. Pesticides leave the target area by degradation or breakdown, evaporation to the atmosphere, leaching to ground water, and runoff to surface water.

Runoff is the most direct route to surface ponds, lakes, or streams. Even if no body of water is visible, runoff may reach a water body by way of ditches, storm sewers, or underground drainage pipes. This is a concern particularly in subdivisions where numerous manicured lawns are treated with pesticides and fertilizers.

Recommendations

1. Always read the label before purchasing a pesticide. Read it again before applying.
2. Do not apply pesticides when rain is imminent. Pesticides need time to dry and work.
3. Do not spray pesticides when it is windy.
4. Note the temperature range specified on the label. High temperature may increase evaporative loss or cause plant injury.
5. Use the correct amount of water. If too much water is used, the pesticide may not work properly and may be more likely to run off.
6. Calibrate your sprayer. Too little won't work. Too much may damage the environment.
7. Use Integrated Pest Management (IPM) to control pests.
8. To protect ground water, select pesticides with low leaching potential.
9. To protect streams and lakes, consider runoff potential.
10. Where possible, substitute low-toxicity, short-lived chemicals for high-toxicity and long-lived chemicals.
11. Finally, use care when handling chemicals and disposing of the leftover material.

Runoff from such areas can upset nearby ecosystems and threaten wildlife. Pesticides differ in their relative runoff potential, as shown in the following tables.

Leaching is the extraction of chemicals from soil by water moving through the soil. Most pesticide chemicals degrade rapidly in soil. But, if they are highly leachable, they may reach ground water before they are degraded. In rainy periods or when there is excessive irrigation, leachable chemicals are likely to move to ground water. The tables show the relative leaching potential of commonly used chemicals.

Degradation is the time it takes a pesticide to degrade (break down into simpler substances). Degradation rate is measured by half-life—the time it takes for half of the active ingredient to break down. For example, half-life of the insecticide Sevin is 10 days. Therefore, one ounce of active ingredient would degrade to a half ounce in 10 days. In another 10 days, only one-fourth ounce (half of a half ounce) would remain, and so on. Materials with a shorter half-life are less persistent than those with a longer half-life. Tables 1 through 3 show the degradation rate, expressed as half-life in soil, for some commonly used pesticides.

Evaporation (or volatilization) is the loss of pesticide to the atmosphere. In most cases, this is not a big concern for water quality, although some evaporated pesticide may return to earth on dust particles or in rainfall. Evaporation can also contribute to air pollution. Perhaps the biggest concern is that evaporative loss reduces the effectiveness of the pesticide, requiring extra pesticide treatments with more handling, rinsings, and disposal problems.

Integrated Pest Management for Residential Areas

Integrated Pest Management (IPM) uses biological principles, cultural practices, and some chemicals to control pest populations with minimal environmental impact.

- Select adapted plant materials, considering resistance to commonly occurring pests.
- Select high-quality seed or sod, free of weeds, insects, and disease.
- Use proper planting and establishment techniques to minimize perennial weeds and other problems.
- Manage fertility with soil tests to maintain vigorous growth without excess fertilizer.
- Identify status and abundance of pests.
- Adjust cultural practices, such as mowing, fertilization, irrigation, aerification, and dethatching. Use mechanical alternatives, such as hand pulling or cultivation, instead of a pesticide.
- Use spot treatments instead of broadcast application.

Impact of Pesticides on Aquatic Organisms

Pesticides in the environment are generally a concern because they kill organisms other than the target insect, weed, or disease organism. Toxicity varies by species and may be either acute or chronic. **Acute toxicity** is fast-acting, affecting organisms directly. **Chronic toxicity** is more subtle. It results from low-level, frequent exposure, and its effects may not be recognized until much later.

Acute toxicity is measured by testing the chemical on a population of organisms, such as invertebrates, fish, or birds. Toxicity is reported as the median lethal dose (LD_{50}) or the median lethal concentration (LC_{50}). LD_{50} is the dose (mg of chemical/kg of body weight) that will kill 50 percent of the designated organisms in a specified period of time, usually 24 to 96 hours. The lower the LD_{50} or LC_{50}, the more dangerous the chemical. Toxicity of some commonly used pesticides to mallard ducks, fish, and aquatic invertebrates is shown in the tables.

Bioaccumulation

Bioaccumulation is the concentrating effect that occurs when many microscopic organisms, contaminated by pesticides, are eaten by organisms higher in the food chain. For example, DDT sprayed on insects accumulated in small mammals, birds, and people. The concentration of pesticides in the tissue of organisms at the top of the food chain may be far greater than the concentration in the water or surrounding environment. Accumulated pesticide may kill the higher organism, or it may have more subtle effects, such as reducing the organisms reproductive capabilities. Today's pesticides do not bioaccumulate.

Reducing Environmental Impact

Pesticide formulation, application timing, and application method can affect runoff and leaching. For example, if it rains, wettable powder formulations are much more likely to be washed off a surface than are emulsified concentrate formulations.[3] Timing is important because effectiveness varies with growth stage and pest population. Spraying for a pest that is not present can waste chemicals and threaten the environment. Likewise, some application methods, such as spot treatment, may be better than broadcast spay.

Pesticide selection can be adjusted to avoid known problems. For example, if soils are sandy or ground water is near the surface, a pesticide with low leaching potential is desirable. If a pond with fish or ducks is

References

1. Extoxnet, 1989. "Pyrethrins and Pyrethroids." Michigan State University.
2. Terrell, C. R., and P. B. Perfetti. 1989. Water Quality Indicators Guide: Surface Waters, U. S. Dept. of Agriculture, Soil Cons. Serv. SCS-TP-161.
3. Water Quality Reference Handbook. 1988. USDA-SCS.
4. Hartley, D., and H. Kidd, (Eds.). 1983. The Agrochemicals Handbook, 2nd ed. The Royal Society of Chemistry, The University Nottingham, England.
5. "Avian Single-Dose Oral LD_{50}." 1985. Hazard Evaluation Division Standard Evaluation Procedure. Environmental Protection Agency, Washington D.C.
6. Toth, S. J., G. L. Jensen, and M. L. Grodner. "Acute Toxicity of Agricultural Chemicals to Commercially Important Aquatic Organisms." Louisiana Coop. Ext. Serv. Publ. 2343.
7. Smith, G. 1970. Pesticide use and toxicity in relation to wildlife—organophosphorus and carbamate compounds. U.S. Dept. of Fish and Wildlife Serv. Res. Publ. Washington D.C.
8. Johnson, W. W. , and M. T. Finely. 1980. Handbook of acute toxicity of chemical to fish and aquatic invertebrates. U.S. Dept. of Int., Fish and Wildlife Serv. Res. Publ. 137. Washington D.C.
9. Hudson, R. H., R. K. Tucker, and M. A. Haegele. 1984. Handbook of Toxicity of Pesticides to Wildlife, 2nd ed. U.S. Dept. of Int., Fish and Wildlife Serv. Res. Publ. 153. Washington D.C.
10. Hornsby, A., and Audustgin (Eds.). 1991. Pesticide Parameter Database. In: Handbook on Managing Pesticides for Crop Production and Water Quality Protection. SS-SOS-3.

Table 1. Characteristics of commonly used insecticides.

Insecticides	Relative Runoff Potential[2,3]	Relative Ground Water Leaching Potential[3]	Half-life in Days[3,10]	Relative Toxicity[a,b]		
				Mallards	Fish[c]	Invertebrates
Affirm (Abamectin)				medium	medium	
Amdro (Hydramethylnon)	large	very small	10	very low	high[e]	
Baygon (Propoxur)				high	medium	
Cygon (Dimethoate)	small	medium	7	high	medium	
Diazinon (Diazinon)	medium	large	30	very high	high	
Dursban (Chlorpyrifos)	large	small	30	medium	very high[d]	
Dylox (Trichlorfon)	small	large	27	high	high	
Ficam/Turcam (Bendiocarb)			5			
Kelthane (Dicofol)	large	small	60		high	
Malathion (Malathion)	small	small	1	low	very high[e]	
Methoxychlor (Methoxychlor)			120	very low	very high	high
Oftanol (Isofenphos)			150			
Omite (Propargite)	large	small	56	very low	high[e]	
Orthene (Acephate)	small	small	3	medium	very low	
Pentac (Dienochlor)					high	
Pyrethrins (Pyrethrins)				very low	very high	
Rotenone (Rotenone)				very low	very high	very low
Sevin (Carbaryl)	medium	small	10	very low	medium	medium
Tempo (Cyfluthrin)			30	very low	very high	

[a]Toxicity to mallard ducks[1,4,7,9] is based on LD_{50}
- very low = more than 2,000mg/kg
- low = >500 to 2,000
- medium = >50 to 500
- high = 10 to 50
- very high = less than 10mg/kg

[b]Toxicity to fish[4,6,8] and aquatic invertebrates[1,8] is based on 48- or 96-hour LC_{50}
- very low = more than 100mg/l
- low = >10 to 100
- medium = >1 to 10
- high = 0.1 to 1
- very high = less than 0.1mg/l

[c]Fish toxicity based on catfish and bluegill

[d]Catfish are less sensitive

[e]Bluegill are less sensitive

nearby, the chemical's runoff potential and its specific toxicity should be considered.

Care in application and disposal. Improper handling of chemicals, indiscriminant spraying, and dumping are serious concerns. Do not apply more pesticide than allowed by the product's label, and never pour pesticide in a storm sewer or other channel.

Water management. Over-watering lawns can leach pesticides below the reach of plant roots. This increases the chance of contaminating ground water, particularly if the chemical has high leaching potential.

Identify your pests and use Integrated Pest Management (IPM) [see box on page 2]. Exploring the options for pest control may require expert advice, as well as personal research. For information about pest identification and IPM, visit your County Extension Office.

Table 2. Characteristics of commonly used herbicides.

Herbicide	Relative Runoff Potential[2,3]	Relative Ground Water Leaching Potential[3]	Half-life in Days[3,10]	Relative Toxicity[a,b]		
				Mallards	Fish[c]	Invertebrates
Arsonate/Bueno (MSMA Soluble Salt)	large	small	100		very low	
Balan (Benefin)	large	small	30	very low	very high	
Banvel (Dicamba Soluble Salt)	small	large	14	low	low	very low
Betasan (Bensulide)	large	small	120			
Dacamine/Weedar (2, 4-D)	small	medium	10		very low[d]	
Dacthal [DCPA (Chlorthaldimethyl)]	large	small	100		very low	
Devrinol (Napropamide)	large	medium	70			
Dicamba (Dicamba)				low	low	
Endothal (Endothall)			7			
Kerb (Pronamide)	large	small	60			
Mecoprop (MCPP) Soluble Amine Salt	small	large	21		low	
Montar/Phytar 560/ Rad-E-Cate						
Pendimethalin (Pendimethalin)	large	small	90	very low	high	
Ronstar (Oxadiazon)			60	low	medium	
Roundup/Kleenup (Glyphosate Amine Soluble Salt)	large	small	47		very low	medium
Sencor (Metribuzin)	medium	large	40	very low	medium	medium

[a]Toxicity to mallard ducks[1,4,7,9] is based on LD_{50}
very low = more than 2,000mg/kg
low = >500 to 2,000
medium = >50 to 500
high = 10 to 50
very high = less than 10mg/kg

[b]Toxicity to fish[4,6,8] and aquatic invertebrates[1,8] is based on 48- or 96-hour LC_{50}
very low = more than 100mg/l
low = >10 to 100
medium = >1 to 10
high = 0.1 to 1
very high = less than 0.1mg/l

[c]Fish toxicity based on catfish and bluegill

[d]2,4-D butoxyethanol ester has medium to high toxicity to fish

Table 3. Characteristics of commonly used fungicides.

Fungicide	Relative Runoff Potential[2,3]	Relative Ground Water Leaching Potential[3]	Half-life in Days[3,10]	Relative Toxicity[a,b]		
				Mallards	Fish[c]	Invertebrates
Banner (Propiconazole)	medium	medium	110		medium	
Bayleton (Triadimefon)	medium	medium	26		low	
Benlate/Tersan (Benomyl)	large	small	240	low	very high[d]	
Bordeaux Mix (Bordeaux Mix)						
Captan (Captan)			3	very low	very high[d]	
Carbamate (Ferbam)	medium	medium	17			
Cyprex (Dodine Acetate Soluble Salt)	large	small	20[10]	low		
Daconil (Chlorothalonil)	large	small	30	very high	very high	very high
Dithane/Manzate (Mancozeb)	large	small	70		medium	
Dithane (Maneb)	medium	small	70[10]			
Dyrene (Anilazine)	small	small	1	very low	high	
Folpet (Folpet)				low	medium	
Funginex (Triforine)	medium	small	21		very low	
Fungo/Topsin (Thiophanate-methyl)	small	medium	10[10]			
Karathane (Dinocap)	medium	small	5	low	medium	
Koban/Terrazole/Truban (Etrazol/Etridiazole)	large	small	103[10]			
Ornalin/Vorlan (Vinclozolin)	medium	medium	20			
Pipron (Piperalin)	medium	small	30			
Rubigan (Fenarimol)	medium	small	360	very low	high	
Subdue (Metalaxyl)	small	medium	70		low	
Terraclor/Trufcide (PCNB)	large	small	21	very low		

[a]Toxicity to mallard ducks[1,4,7,9] is based on LD_{50}
very low = more than 2,000mg/kg
low = >500 to 2,000
medium = >50 to 500
high = 10 to 50
very high = less than 10mg/kg

[b]Toxicity to fish[4,6,8] and aquatic invertebrates[1,8] is based on 48- or 96-hour LC_{50}
very low = more than 100mg/l
low = >10 to 100
medium = >1 to 10
high = 0.1 to 1
very high = less than 0.1mg/l

[c]Fish toxicity based on catfish and bluegill

[d]Bluegill are less sensitive