Best Management Practices For Agricultural Pesticide Use

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Best Management Practices for Agricultural Pesticide Use

Pesticides are widely used to protect crops and livestock from losses due to insects, weeds, and diseases. Colorado uses about 1% of the 1.2 billion pounds of pesticide applied annually in the United States. The Environmental Protection Agency (EPA) has estimated that 70% of the total pesticide use is for agricultural production, with the remaining 30% used in the urban, industrial, forest, and public sector. These chemicals have helped to increase agricultural production with reduced labor. However, problems associated with improper pesticide use have led to human illness, wildlife losses, and water quality degradation.

The major groups of pesticides include insecticides, herbicides, and fungicides. Herbicides are the most widely used class of agricultural pesticides and subsequently have been the most frequently found in ground and surface water. Until fairly recently, it was thought that pesticides applied to agricultural fields were broken down or tied up before they could reach groundwater. However, the development of extremely sensitive detection methods has led to the discovery that commonly used management practices may lead to small amounts of pesticide contaminating ground and surface water supplies. Since rural residents depend on these water supplies, agricultural producers need to exercise a high level of management to avoid contamination.

This guide addresses Best Management Practices (BMPs) for preventing nonpoint source contamination of water resources by agricultural pesticides. Contamination from normal pesticide application is called nonpoint contamination, since a single point of contamination cannot be identified. Point source contamination would include spills of concentrated chemicals at storage, mixing, or loading sites. These point source problems are addressed in the document *BMPs for Pesticide and Fertilizer Storage and Handling.*

Since pesticides are an important tool for most farming operations, and cleaning up contaminated groundwater is extremely difficult, producers need to evaluate their use of pesticides and adopt BMPs that are appropriate for their crops and site. Fortunately, a number of crop management and pesticide application practices are available that can be used to reduce potential contamination of water supplies.

Government Regulations and Policy

The federal government has enacted several laws to control pollution of water resources. Among these are the Safe Drinking Water Act, the Clean Water Act, and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). All pesticides are regulated through FIFRA, and producers should understand that the chemical label is, in effect, the law. In most cases, the precautions on the chemical label are adequate to protect water resources from contamination above a regulatory standard. However, it is possible for a pesticide to reach ground or surface water resources, even when used according to the label. Chemicals that have a higher potential to move to groundwater are identified on the label by a “Ground Water Advisory Statement.” Producers should take special care when using these chemicals on sites with conditions that increase the chance of leaching or runoff (Table 1).

Table 1. Pesticides with groundwater advisory statements*

Trade name	Common name
Lasso	alachlor
Temik	aldicarb
Aatrex	atrazine
Bromex	bromacil
Furadan	carbofuran
Bladex	cyanazine
2,4-D	2,4-D
MCPP	mecoprop
Dual	metolachlor
Sencor	metribuzin
Vydate	oxamyl
Tordon	picloram
Princep	simazine
Currently under review	
Dyfonate	fonophos
Dacthal	DCPA
Telone	dichloropropene

*Current as of 10/94

The Colorado Legislature addressed public concerns about groundwater quality by passing the Agricultural Chemicals and Groundwater Protection Act (SB 90-126). This act declares that the public policy of Colorado is to protect groundwater and the environment from impairment or degradation caused by improper use of agricultural chemicals, while allowing for their proper and correct use.

Rather than impose overly restrictive measures on farmers and related industries, Colorado has elected to encourage the voluntary adoption of BMPs that suit the agricultural chemical user's specific managerial constraints, while still meeting environmental quality goals. Voluntary adoption of these measures by agricultural chemical users will help maintain the quality of water resources, improve public perception of the industry, and perhaps eliminate the need for further regulation and mandatory controls.

Groundwater Monitoring

The Colorado Department of Health and Environment has the primary responsibility for conducting water quality monitoring programs in Colorado to determine water quality status and enforce health and drinking water standards. Colorado Senate Bill 90-126 requires the Department of Health to conduct a statewide groundwater monitoring program and aquifer vulnerability analyses. Monitoring is the only reliable way to assess the presence of pesticide in groundwater, since pesticides are normally tasteless, odorless, and colorless at low concentrations.

Today, water quality monitoring studies in areas where agricultural chemicals have been used are likely to detect some of these chemicals, partly because of an ever increasing ability to measure chemicals in smaller quantities. Laboratory techniques now exist that allow the detection of chemicals in levels as minute as parts per trillion.

The groundwater monitoring conducted so far in Colorado has detected several pesticides, including: atrazine, EPTC, 2,4-D, alachlor, cyanazine, metribuzin, chlorothalonil, metolachlor, prometon, and several others in small amounts (generally in the parts per billion range). As groundwater monitoring efforts advance, the presence of pesticide in Colorado groundwater appears to be minimal compared to some of the other agricultural states.

Drinking Water Standards

The EPA has established primary drinking water standards or health advisory levels for a number of pesticides. Primary drinking water standards are referred to as maximum contaminant levels (MCLs) and are the highest amount of a contaminant allowed in public water systems. Currently, 26 pesticides have established MCLs, with more expected in the future.

EPA health standards for groundwater contamination by a pesticide are based on a lifetime exposure level that would conservatively increase cancer risk by one in one million. These standard values are calculated with the assumption that you will drink 2 liters of contaminated water every day for 70 years. The actual MCL values are set by considering the potential health effects, as well as the feasibility and cost of treatment. Obviously, there is a certain level of uncertainty in these factors, so regulatory agencies tend to be extremely conservative in order to protect public health.

If you have questions about the EPA's drinking water standards and policies, or want more information about drinking water, call the EPA drinking water hotline at 1-800-426-4791.

Pesticide Fate in the Environment

Pesticides meet a variety of fates after application. They may evaporate, be broken down by sunlight, or be carried away to surface water before reaching their targets. After reaching the soil, they may be taken up by plants, adsorbed to soil particles, broken down by soil microorganisms, or in some cases be moved off-target to water resources (Figure 1). The fate of pesticides in the environment depends upon a number of factors, including:

- soil characteristics
- site features
- pesticide properties
- pesticide use practices.

Usually the majority of applied pesticide is degraded to harmless products by soil microbes. However, some pesticide may reach ground or surface water if the appropriate BMPs are not implemented. Applicators should always evaluate the characteristics of their site and pest problems to determine the best control measure with the least potential for environmental hazard. (For more information, see *BMPs for Crop Pests.*)

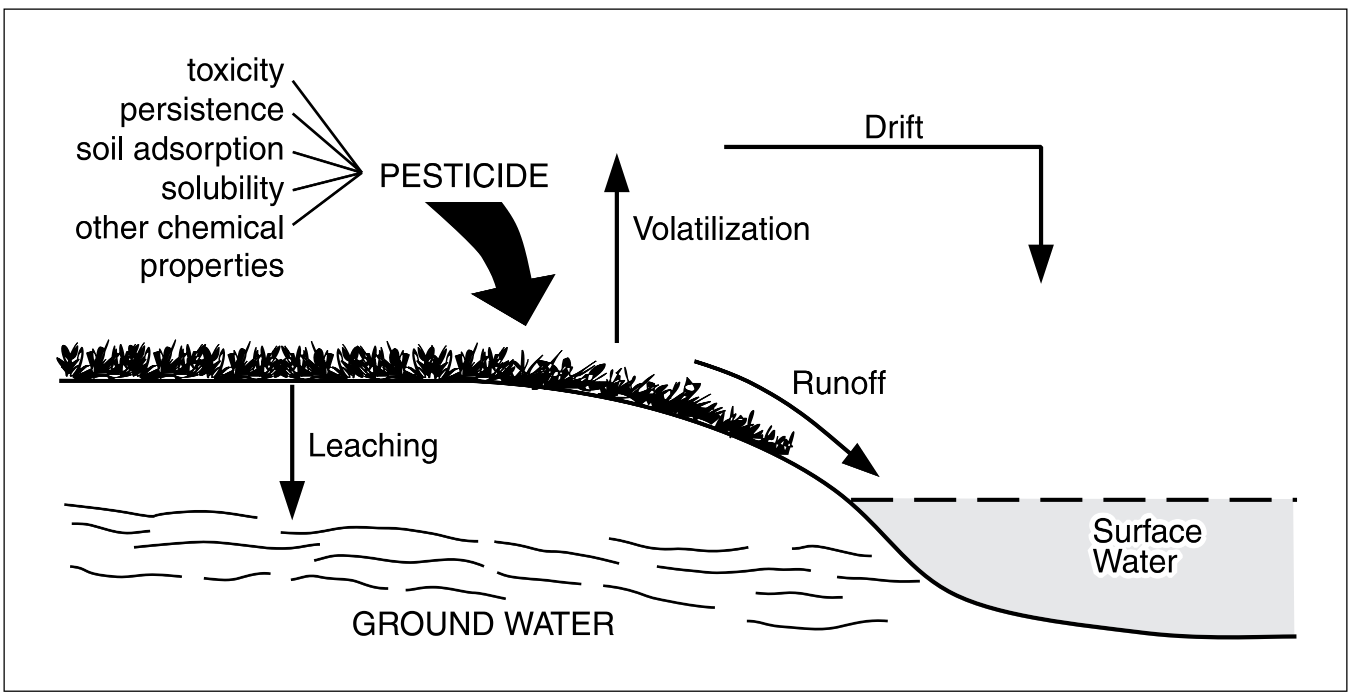

Figure 1. Many factors influence pesticide transport and impact on water quality.

Soil Characteristics

Soil properties and water management can significantly affect pesticide movement in the environment. The most significant soil characteristics are:

- soil structure and macropores
- soil texture
- soil organic matter content
- soil moisture content
- soil pH.

Soil structure, the way soil particles are aggregated, significantly affects water movement and may allow pesticides to move through the profile before they can be adsorbed or degraded. Large soil cracks or openings (macropores) caused by heaving, roots, or soil animals can cause rapid pesticide movement, even in fine soils with high organic matter. Soils characterized by high numbers of macropores are poor candidates for chemigation because the chemical can move rapidly downward below the root zone.

Soil texture refers to the proportion of sand, silt, and clay particles in the soil. Texture affects the surface charge and the surface area for pesticide adsorption. Soils with a higher clay content have a greater ability to hold pesticides, but they are more susceptible to runoff and need to be managed accordingly. Sandy soils leach more readily and provide fewer sites for pesticide adsorption. Soils with a high sand content should be managed carefully, with minimal use of persistent or very mobile pesticides.

Organic matter (OM) content is considered the single most important soil property affecting pesticide adsorption. Pesticides are very strongly attracted to the surface of organic matter and are less likely to leach in soils high in organic matter. Applicators working on soils with less than 1% organic matter should be aware of the possibility of pesticide leaching.

Unfortunately, the above soil factors are very difficult, if not impossible, for a producer to change. However, these characteristics should alert producers to the likelihood of leaching at their sites.

One of the most significant factors affecting runoff or leaching is the soil moisture condition at the time of pesticide application. In the semi-arid climate of Colorado, producers often can manage pesticide application and irrigation to avoid conditions leading to pesticide loss. Pesticides with medium or high mobility should not be applied to a saturated soil or just prior to a heavy irrigation. Alternative pest management strategies should be considered when the soil moisture status increases the probability of runoff or leaching. *(See BMPs for Crop Pests.)*

Site Features

In addition to soil type, other features of the application site can affect the potential for pesticide movement offsite. The site characteristics of greatest concern include:

- depth to groundwater
- proximity to surface water
- topography
- aquifer and overburden characteristics
- climate and irrigation.

Distance to water is one of the most significant site features to be aware of when evaluating pest management decisions. When the water table is close to the soil surface (less than 30 feet), contamination of groundwater is much more likely than when groundwater resources are deep. Surface water proximity should also be considered prior to pesticide application. Observe a setback or buffer zone a safe distance from wells, streams, ponds, and lakes. Do not apply pesticides in these zones. The actual setback required will depend upon the mobility of the chemical, slope, and likelihood of runoff.

The permeability of subsurface layers affects the rate of groundwater recharge and subsequent contamination if any pesticide is carried in percolating water. Regions with highly permeable materials, such as those found over alluvial aquifers in Colorado or in the San Luis Valley, are particularly susceptible to contamination. These vulnerable areas merit careful pesticide selection and application methods, especially where irrigation may result in excess water for leaching.

Pesticide Properties

Chemical properties of a pesticide cannot be changed by applicators, but they can be used to select the most appropriate product when chemical control is necessary (Table 2). Properties of special interest that influence the likelihood of off-target affects include:

- degradation rate
- adsorptivity
- solubility
- volatility.

The degradation rate of a pesticide, measured as the half-life, indicates how long the chemical persists in the environment. Persistence is significant because the longer a chemical is subject to the forces of leaching, the greater the probability the chemical will end up in groundwater.

The major pathways of pesticide degradation are microbial breakdown, photolysis (breakdown by sunlight), and hydrolysis (chemical breakdown). These pathways are influenced by the chemical structure of the pesticide compound, as well as by soil temperature, pH, moisture, and microbial populations. Soil microbes, including bacteria, fungi, and actinomycetes are the major degradation pathway for most pesticides. Since microbes tend to be most active in the rootzone, once a pesticide moves below this level it may be stable long enough to reach groundwater.

Adsorptivity is a measure of how strongly a pesticide is attracted to the negative charges on soil particles. Strongly adsorbed pesticides are less likely to leach, especially on soils with high OM or clay content. However, they may be more prone to end up in surface water if soil erosion occurs because of wind or water. Adsorptivity is usually expressed as the K_D or K_{OC} of the compound. The higher the number, the more strongly adsorbed the pesticide will be.

Solubility, usually expressed in parts per million (ppm), describes the tendency of a pesticide to dissolve in water. While solubility may influence the amount of a chemical carried in macropore flow, it is generally not as significant as the adsorptivity of a chemical in predicting chemical movement through soil.

Volatility is the measure of how fast a chemical evaporates when in contact with air. Volatile pesticides can move off-target by vapor drift. Although it seems unlikely, even highly volatile chemicals such as EDB and DBCP have been found in groundwater as a result of normal use.

Table 2. Physical properties and predicted mobility of selected pesticides

Trade name	Common name	Soil sorption index	Water solubility	Soil half-life	Predicted mobility Surface runoff	Leaching
Herbicides		(K_{oc})	(ppm)	(days)		
Aatrex	atrazine	100	33	60	medium	small
Banvel	dicamba	2	500,000	14	small	large
Basagran	bentazon	35	2,300,000	20	medium	large
Bladex	cyanazine	190	170	14	medium	medium
Buctril	bromoxynil	190	<1	5	medium	small
Curtail	clopyralid	1	300,000	30	small	large
Dacthal	DCPA	5000	<1	100	large	small
Dual	metolachlor	200	530	20	medium	medium
Eptam	EPTC	280	375	30	medium	medium
Eradicane	EPTC	280	375	30	medium	medium
Far-Go	triallate	2400	4	82	large	small
Goal	oxyfluorfen	100,000	<1	35	large	small
Gramoxone	paraquat	100,000	1,000,000	500	large	small
Lasso	alachlor	170	240	15	medium	medium
Prowl	pendimethalin	24,300	<1	90	large	small
Roundup	glyphosate	24,000	900,000	47	large	small
Sencor	metribuzin	41	1220	30	medium	large
Stinger	clopyralid	1	300,000	30	small	large
Sutan	butylate	126	46	12	medium	medium
2,4-D Amine	2,4-D amine	20	796,000	10	small	medium
Tordon	picloram	16	200,000	90	small	large
Treflan	trifluralin	7000	<1	60	large	small
Velpar	hexazinone	54	33,000	90	medium	large
Insecticides						
Ambush	permethrin	86,600	<1	32	large	small
Asana XL	esfenvalerate	5300	<1	35	large	small
Counter	terbufos	3000	5	5	medium	small
Cygon	dimethoate	8	25,000	7	small	medium
Diazinon	diazinon	500	40	40	medium	medium
DiSyston	disulfoton	1600	25	5	medium	small
Dyfonate	fonofos	532	13	45	large	medium
Endocide	endosulfon	2040	32	120	large	small
Furadan	carbofuran	22	351	50	small	large
Kelthane	dicofol	8,000,000	1	60	large	small
Malathion	malathion	1800	145	1	small	small
Orthene	acephate	2	818,000	3	small	small
Parathion	parathion	5000	24	14	large	small
Penncap-M	methyl parathion	5100	60	5	medium	small
Pounce	permethrin	86,000	<1	32	large	small
Pydrin	fenvalerate	5300	<1	35	large	small
Sevin	carbaryl	200	114	10	medium	small
Temik	aldicarb	30	6000	30	small	large
Thimet	phorate	2000	22	90	large	small

Table 2 (cont). Physical properties and predicted mobility of selected pesticides

Trade name	Common name	Soil sorption index	Water solubility	Soil half-life	Predicted mobility Surface runoff	Leaching
		(K_{oc})	(ppm)	(days)		
Fungicides						
Bayleton	triadimefon	273	260	21	medium	medium
Benlate	benomyl	190	2	240	large	large
Bravo	chlorothalonil	1380	<1	30	large	small
Captan	captan	100	4	3	small	small
Dithane	mancozeb	2000	<1	70	large	small
Maneb	maneb	1000	<1	60	large	small
Manzate	mancozeb	2000	<1	70	large	small
Ridomil	metalaxyl	16	7100	21	small	large
Telone II	dichloropropene	32	2250	10	small	medium
Tilt	propiconazole	100	110	20	medium	medium
Vitavax	carboxin	264	170	7	medium	small

Source: NRCS Pesticide Database, 1993.

For more information, contact your local NRCS office.

Pesticide properties only indicate the probability of leaching or runoff; soil, site, and management factors must also be considered. Even if pesticide properties indicate very little environmental risk, they may still end up in water supplies if other factors favor movement. However, in most cases good management will keep water contamination to a minimum.

Determining Pesticide Loss Potential

Pesticide applicators should evaluate all soil, site, and pesticide properties to determine the relative hazard to water resources that pesticide application may pose. By considering these factors, pest management measures that are least likely to impact ground or surface water can be selected (Table 3).

Leaching

Take care with sites vulnerable to leaching when considering pesticides that are poorly adsorbed or have long persistence in the environment. If possible, select chemicals with low toxicity, short half-lives, and high adsorption. This information is usually available from your chemical dealer, Extension agent, or crop adviser.

Several computer models have recently been developed to predict pesticide movement and to help choose the most appropriate pest management strategy. The Natural Resource Conservation Service (NRCS) has developed a Pesticide Leaching Matrix and a Surface Runoff Matrix which can be used to compare pesticide properties with features of Colorado soils. Applicators should visit their local NRCS office for more information on the use of specific pesticides on their sites. Contact a professional crop adviser if you need help designing an Integrated Pest Management program that reduces reliance on pesticides.

Table 3. Factors influencing pesticide leaching potential

Soil characteristics	Numeric guidelines*
sandy soil	
low organic matter	less than 1% OM
numerous macropores	
Pesticide properties	
long half-life	greater than 21 days
low adsorptivity	K_{OC} less than 300-500
high solubility	greater than 30 ppm
Site features	
shallow groundwater	less than 30 feet deep
permeable overburden	
excess irrigation water	

*These numeric guidelines are only indicators that a hazard may exist. Actual leaching depends upon the interaction of site and management factors.

Runoff

Pesticides have routinely been found in surface waters receiving agricultural runoff, particularly after heavy spring rainfall. This suggests that the management of pesticides should focus on good practices at the time of application. Additionally, land management practices such as reduced tillage are important for protecting surface water quality. Grass filter strips and waterways should be established on the down gradient side of fields that drain directly to streams and lakes.

Conservation tillage practices that increase the amount of crop residues on the soil surface can reduce runoff volume and velocity, resulting in less erosion and pesticide movement. Strongly adsorbed chemicals, such as paraquat, tend to adhere tightly to soil particles and will move only on eroding sediments. Reduced tillage systems are highly recommended on all erosive soils. However, in some cases increased macroporosity and infiltration, coupled with increased herbicide use, may favor pesticide leaching. Where groundwater is shallow and domestic wells are nearby, these trade-offs should be assessed.

Pesticide Use Practices

Although pesticide use is a standard practice in most agricultural operations, many producers are adopting an Integrated Pest Management (IPM) approach. IPM techniques can reduce pesticide use to the minimum amount necessary to produce high quality food, while maximizing profits.

IPM combines chemical control with cultural and biological practices to form a comprehensive program for managing pests. This approach emphasizes preventive measures to maintain pests below the economic threshold while using the minimum amount of pesticide necessary. However, using the proper pesticide at the time of maximum pest susceptibility is often critical to an effective IPM program.

IPM is the primary BMP for pest management. It includes practices such as:

- monitoring pest and predator populations
- selecting crops and varieties that are resistant to pest pressures
- timing planting and harvest dates to minimize pest damage
- rotating crops
- employing beneficial insects and other biological controls.

Changing your pest management strategy to an IPM program may involve modifying tillage, fertility, cropping sequence, and sanitation practices. This may require some experimentation and perhaps even professional help.

Pesticide Application Practices

When pesticides are required to control pests, it is important to use application techniques which lessen potential water quality impacts. All applicators should become certified and remain current in new developments in pest management.

Pesticides should be applied at a time when they will be most effective against the crop pest. Pest cycles are influenced by temperature and moisture conditions. In many cases, pests under dormant or stressed conditions may not be susceptible to pesticide treatments.

Apply the lowest labeled pesticide rate that adequately controls pests. Lower rates reduce the total amount of chemical in the environment. Rotate pesticides among chemical families to minimize pest resistance. IPM does not rely on continuous use of a single pesticide or pesticide family. Avoid pesticide applications during adverse weather, especially windy, wet conditions. Do not apply volatile chemicals such as 2,4-D ester or methyl parathion under high temperature conditions.

Table 4. Herbicide families and selected herbicides*

Family	Common name	Trade name(s)
Benzoic acids	dicamba	Banvel
Phenoxy acids	MCPA 2,4-D	
Phenoxypropanoates	diclofop fluazifop sethoxydin	Hoelon Fusilade Poast
Pyridines	picloram clopyralid	Tordon Stinger
Amino acid derivatives	glyphosate	Roundup
Hydroxynitriles	bromoxynil	Buctril
Sulfonylureas	chlorsulfuron sulfometuron metsulfuron trisulfuron nicosulfuron primisulfuron fulmetsulam	Glean Oust Ally Pinnacle Accent Beacon Broadstrike
Imidazolinones	imazapyr imazethorpyr imamethabenz	Arsenal Pursuit Assert
s-triazines	atrazine simazine cyanazine hexazinone	 Princep Bladex Velpar
as-triazines	metribuzin	Sencor/Lexone
Quaternary ammoniums	diquat paraquat	
Dinitroanilines	trifluralin ethalfluralin pendimethalin	Treflan Sonalan Prowl
Thiocarbamates	butylate cycloate triallate EPTC	Sutan[+] Ro-Neet Buckle Eptam, Eradicane

Table 4 (cont). Herbicide families and selected herbicides

Family	Common name	Trade name(s)
Anilides	alachlor	Lasso
	metolachlor	Dual
	propachlor	Ramrod
	acetochlor	Harness Plus, Surpass
	dimethenamid	Frontier
Uracils	bromacil	Hyvar
	terbacil	Sinbar
Ureas	linuron	Lorox
Phenylcarbamates	phenmedipham	Betanal
	desmedipham	Betanex
Pyridazinones	pyrazon	Pyramin
Miscellaneous	bentazon	Basagran
	ethofumesate	Nortron
	pyridate	Tough, Lentagran

*Chemicals within the same family have similar modes of action and should be rotated to avoid weed resistance.

The application method used to apply pesticides can influence leaching or runoff potential. Soil injection or incorporation makes the pesticide most available for leaching, but least likely to cause surface water contamination. In general, preplant and preemergence treatments on clean tilled soil are more subject to surface loss than postemergence treatments, when crop cover reduces runoff. Foliar insecticide and postemergence herbicide treatments may reduce the potential for chemical movement because of rapid absorption by plants. Additionally, many of the foliar or postemergence chemicals are less persistent and can sometimes be used effectively at lower rates.

Banding herbicides over the crop row is a BMP that can significantly reduce chemical costs while maintaining yields. Many producers are using a 10- to 15-inch band, reducing total herbicide use by 50% or more. Banding may require an extra cultivation and slightly more management, but it does not involve sophisticated equipment or a large investment. Existing application and tillage equipment usually can be modified. Spot pesticide treatments in the pest-affected areas of a field can also control pests to within economic levels with much less chemical than broadcast applications. The reduced amount of pesticide used under band and spot applications can result in higher returns and less pesticide available for leaching or runoff.

Calibration and Equipment Maintenance

Effective pesticide use requires uniform application of the correct amount of chemical and carrier. Under-application usually results in poor control, which may require re-treatment. Over-application of pesticide seldom increases control and may result in crop damage and needless environmental risk.

Calibrate spray equipment prior to each application and maintain all equipment according to the manufacturer's recommendation. Check hoses, booms, tanks, and nozzles regularly for uneven wear and leaks or drips.

Information on proper calibration of field sprayers is available from a number of sources. Check with your local chemical dealer, crop consultant, or Extension agent for help calibrating your equipment properly.

Broadcast Sprayer Calibration Formula

$$\text{Gallons per acre} = \frac{\text{Gallons/nozzle/minute} \times 12 \times 43560}{\text{nozzle spacing} \times \text{speed}}$$

$$\text{Gallons/nozzle/minute} = \frac{\text{Ounces collected in 1 min. from 1 nozzle}}{128}$$

Nozzle spacing = Distance in inches between nozzles on spray boom

Speed = mph x 88

Recordkeeping

Keeping accurate records of all agricultural chemicals applied on your site will help you make informed management decisions. By law, records of all restricted use pesticides must be maintained by operators for at least two years. You can maintain records of nonrestricted chemicals on the same form as the required records with minimal additional effort. This information has further value for use with crop and pest modeling programs and economic analyses. Records kept on all applied pesticides should include:

- product name, formulation, and EPA registration number
- exact location of application
- date of application
- target pest and crop
- size of area treated and amount applied
- name, address, and certification number of applicator,

Other useful information to record includes:

- weather data and irrigation water applied
- description of pest problems
- application rate of chemical and carrier
- equipment calibration data.

Colorado State University Cooperative Extension, as well as several other organizations, have developed recordkeeping forms for restricted use pesticides. Computer software is also commercially available to help producers and applicators maintain good quality records.

Summary

Pesticides are currently an important component of most agricultural pest management strategies. The IPM approach can help producers minimize water quality impacts while managing pests economically. A number of BMPs are effective in reducing pesticide runoff and leaching. Additional benefits of these BMPs include reduction of soil erosion and nutrient losses.

Selection of least toxic chemical controls should be coupled with knowledge of site and chemical interactions. Sites with vulnerable water resources require selection of pesticides least likely to move off-target, or alternative pest management measures. Proper management of soils, water, and pesticides by agricultural producers can help reduce adverse water quality impacts.

Note: The pesticide label always supersedes any educational material such as this publication. Always read and follow label instructions precisely. Data presented in this publication on commercial products are for educational purposes only. Reference to commercial products does not imply endorsement, nor is criticism implied of products not mentioned.

Best Management Practices for Agricultural Pesticide Use

Guidance Principle: Apply pesticides only when needed and use in a manner that will minimize off-target effects.

General BMPs

6.1 Obtain thorough training and the appropriate certification prior to any pesticide use.

6.2 Read all label instructions prior to chemical mixing. All pesticide applications must follow label specifications and must be applied only to the crops for which the product is registered for use in Colorado.

6.3 Keep precise pest and pesticide records. (See Pesticide Recordkeeping Form for suggested format.)

6.4 Consider the effects of pest control measures on the environment and nontarget organisms. Minimize chemical reliance by rotating crops and using mechanical, biological, or cultural pest management measures whenever feasible.

Pesticide Selection BMPS

6.5 Avoid the overuse of preventive pesticide treatments. Base pesticide application on site-specific pest scouting and indicators of economic return.

6.6 Select least toxic and less persistent pesticides when feasible.

6.7 Consider pesticide and target site characteristics to determine suitability of the pesticide at that location. Knowledge of pesticide persistence, mobility, and adsorption should be included in pesticide selection. Chemical applicators should know the characteristics of the application site, including soil texture, organic matter, topography, and proximity to ground and surface water. (Contact your local NRCS office for further information about your site and chemicals.)

Pesticide Application BMPs

6.8 Maintain application equipment in good working condition and calibrate equipment frequently to ensure recommended rates are applied. Replace all worn components of pesticide application equipment prior to application.

6.9 Ensure that the pesticide applicator knows the exact field location to be treated. Post warning signs around fields that have been treated, in accordance with local, state, and federal laws. Follow the established re-entry time as stated on the label.

6.10 Employ application techniques which increase efficiency and allow the lowest effective labeled application rate. Use band and spot applications of pesticides where appropriate to reduce environmental hazards and treatment costs.

6.11 Avoid unnecessary and poorly timed application of pesticides. Optimize pesticide rate, timing, and placement to avoid the need for re-treatment.

6.12 Avoid overspray and drift, especially when surface water is in close proximity to treated fields.

6.13 Time pesticide application in relation to soil moisture, anticipated weather conditions, and irrigation schedules to achieve the greatest efficiency and reduce the potential for off-site transport. Avoid pesticide application when soil moisture status or scheduled irrigation increases the possibility of runoff or deep percolation. After application, manage irrigation to reduce the possibility of erosion or leaching which may transport pesticide from the target site.

6.14 Establish buffer zones where pesticide is not applied a safe distance (minimum of 50 to 100 feet recommended) from wells and surface water.

6.15 Avoid repetitive use of the same pesticide, or pesticides of similar chemistry, to reduce the potential for pesticide resistance development and shifts in the pest spectrum.

6.16 Ensure that backflow prevention devices are installed and operating properly on irrigation systems used for applying pesticides.

Pesticide Safety BMPs

6.17 Read and follow label safety directions, maintain appropriate Material Safety Data Sheets (MSDS), and become certified prior to applying restricted use pesticides.

6.18 Wear the appropriate protective equipment specified on the chemical label to minimize unnecessary exposure to pesticide. Be sure to clean protective gear after each day's use.

6.19 Provide emergency hand and eye wash facilities for personnel who might be accidentally exposed to chemicals, and formulate a safety plan complete with information about locations of emergency treatment centers for personnel exposed to chemicals.

6.20 Know what to do in case of accidental pesticide poisoning. Have a pesticide first aid kit available when handling pesticides. Check the product label for instruction and call the nearest poison center in the event a pesticide is swallowed.

Rocky Mountain Poison Center
Denver, Colorado
(303) 629-1123
1-800-332-3073

Product labels often contain a telephone number where expert information is also available. Take the pesticide label to the attending physician if you need treatment.

For more information about pesticide management or specific inquiries about BMPs, contact Colorado State University Cooperative Extension. They have publications, programs, and specialists available to help you answer questions about water quality.

Related source material from Colorado State University Cooperative Extension:

	Crop Production and Pest Management Field Record
SIA 5.003	**Sprayer Calibration Fundamentals**
SIA 5.021	**Agricultural Protective Equipment**
XCM-45	**Colorado Pesticide Guide for Field Crops**
XCM-43	**Colorado Pesticide Guide for Vegetable Crops**
XCM-178	**Best Management Practices for Pesticides and Fertilizer Storage and Handling**
XCM-176	**Best Management Practices for Crop Pests**
XCM-132	**Persistence and Mobility of Pesticides in Soil and Water**
XCM-41	**Colorado Tree Fruits, Pest and Crop Management Guide**

Pesticide Recordkeeping Form

Farm Name ____

Field I.D. ____

Legal Description ____

Applicator/Supervisor ____

Certification Number ____

Pesticide Applications

Application Date					
Crop/Location Treated					
Size of Treated Area					
Product Name					
EPA Registration No.					
Total Amount of Product Applied					

NOTES: