Best Management Practices For Colorado Agriculture: An Overview

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Principal author: Reagan M. Waskom
Extension Water Quality Specialist
Colorado State University Cooperative Extension

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BMP Technical Review Team: G.E. Cardon, Assistant Professor of Agronomy
R.L. Croissant, Professor of Agronomy
J.J. Mortvedt, Extension Agronomist
G.A. Peterson, Professor of Agronomy
L.R. Walker, Extension Agricultural Engineer
D.G. Westfall, Professor of Agronomy

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Best Management Practices for Colorado Agriculture: An Overview

Public concern regarding drinking water quality and the environment has put the use of agricultural chemicals in the national spotlight. Reports of pesticides and nitrates found in ground and surface water increase the need for farmers, ranchers, and other chemical applicators to modify some common production practices. While many farmers have recently adopted new practices and technology, it may be some time before improvements in water quality can be measured because groundwater changes relatively slowly.

Preventing groundwater contamination is particularly important because once contaminated, it is very difficult and expensive to clean up. The Colorado Legislature addressed this concern in 1990 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 due to the improper use of agricultural chemicals, while allowing for their proper and correct use. The act calls for education and training of all producers and agricultural chemical applicators in groundwater protection and proper use of pesticides and fertilizers.

Rather than legislate overly restrictive measures on farmers and related industries, Colorado has elected to encourage the voluntary adoption of Best Management Practices. These practices are intended to 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 prevent contamination of water resources, improve public perception of the industry, and perhaps eliminate the need for further regulation and mandatory controls.

Best Management Practices

Best Management Practices (BMPs) are recommended methods, structures, and practices designed to prevent or reduce water pollution while maintaining economic returns. The BMPs concept deals specifically with nonpoint source pollution, such as runoff from agricultural fields. Implicit within the BMPs concept is a voluntary, site-specific approach to water quality problems. Many of these methods are already standard practices, known to be both environmentally and economically sustainable.

The goal of BMPs is to protect Colorado water resources from degradation, while maintaining the economic viability of Colorado agriculture and related industries. Ideally, these new practices will improve producer profitability. The BMPs approach encourages voluntary adoption of improved practices by all Colorado citizens using pesticides and fertilizers. Success with voluntary BMPs will depend upon how many farmers and agricultural chemical applicators use them.

BMPs can be classified as either source, structural, cultural, or managerial controls. (See examples on page 2.)

Examples of BMPs by category

Source Controls

- **Voluntary restriction of a labeled pesticide by manufacturer**
- **Mandatory label restrictions by EPA**
- **Local restriction of nitrogen fertilizer application**

Structural Controls

- **Grass waterways and filter strips**
- **Drip and surge irrigation systems**
- **Chemigation backsiphon devices**
- **Irrigation tailwater recovery systems**

Cultural Practices

- **Conservation tillage**
- **Cover cropping**
- **Crop rotation**
- **Application techniques, such as split N application**

Management Practices

- **Integrated Pest Management**
- **Irrigation scheduling**
- **Soil and water analysis**
- **Recordkeeping of pesticide and fertilizer use**

■ **Source controls** are considered the easiest to regulate and implement. They include restriction or removal of a particular pesticide or nutrient source. Such controls are generally accomplished by the EPA for pesticides, or at the state or local level for fertilizers.

■ **Structural controls** usually require some capital outlay and maintenance, but are very effective in controlling water and sediment movement. Cost sharing of these types of controls is often available through the Soil Conservation Service or other agencies.

■ **Cultural controls** are cropping and tillage practices that either minimize pest problems and reduce the need for chemical controls or maximize nutrient use efficiency by conservation and crop rotations.

■ **Managerial controls** are strategies and tools that minimize pollutant losses in ground or surface water. These methods are much more site specific than source or structural controls. A higher level of management enables producers to consider both environmental and economic impacts when choosing production or control methods.

Colorado State University Cooperative Extension and the Colorado Department of Agriculture have been charged by the Colorado Legislature to develop BMPs for Colorado farmers, landowners, and commercial chemical applicators. However, it is recognized that significant local input is needed to develop feasible BMPs for the various cropping areas of the state. Colorado State University Cooperative Extension is working with local producers, applicators, and the Soil Conservation Service to localize BMPs. Opportunities for public comment are offered to acquire a wide spectrum of input. The goal of this approach is to meld producer knowledge and experience with research data to develop improved BMPs.

A set of general **Guidance Principles** has been developed to focus BMPs on the primary water quality goals. Specific BMPs and production alternatives fall under these guidance principles. The BMPs chosen for use at the local level ultimately must be selected by chemical applicators because of the site-specific nature of groundwater protection. Site characteristics such as depth to water table, soil type and water-holding capacity, and climate affect groundwater vulnerability.

For this reason, agricultural chemical users need to know the site-specific variables at the application site, and have a good understanding of agricultural chemical properties and the influence of management practices in order to protect groundwater resources. SB 90-126 allows operators significant local control of BMPs, as long as they meet water quality goals as outlined in the guidance principles.

General Guidance Principles and BMPs

The following guidance principles are intended as general, goal-oriented guidelines to protect water resources. The intent of this approach is to allow operators significant managerial flexibility, while still achieving the goal of protecting our water resources. Under each guidance principle, site-specific BMPs should be selected which are tailored to specific crops and local management constraints. BMPs listed after each of the following guidance principles are examples intended to illustrate possible practices. Refer to the appropriate fact sheets for detailed information on specific BMPs.

To select the BMPs that achieve the environmental quality goals of your operation, consider:

- potential leaching or runoff hazard of the application site
- overall costs and benefits
- short-term and long-term effects on water quality
- most suitable practices for your site and your farm management plan.

Guidance Principle 1

Manage nitrogen applications to maximize crop growth and economic return while protecting water quality.

Excessive rates of fertilizer nitrogen and inefficient irrigation practices can cause nitrate contamination of groundwater. While nitrate contamination can occur naturally or from other human activities, there is an especially high incidence of nitrate contamination in agricultural areas. Over fertilization of urban landscapes can also pose an environmental threat. Proper fertilizer rates, form, and timing are the keys to maximizing plant uptake and minimizing losses. The following are a few of the many BMPs for N fertilizer use:

- sample soil to a minimum depth of 2 feet, preferably to the effective rooting depth, to determine residual NO_3-N
- establish yield goals for each field based upon the previous five-year average, plus a modest increase of about 5%
- credit all sources of available N toward crop N requirements, that is, organic matter and previous crop residues, irrigation water nitrate, soil nitrate, and manure
- use slow release N fertilizers and nitrification inhibitors as appropriate
- split N fertilizer into as many applications as economically and agronomically feasible
- avoid fall application of N fertilizers, especially on sandy soils and over vulnerable aquifers.

What Can City Dwellers Do?

Over application of nitrogen fertilizer and pesticides to lawns sometimes causes groundwater contamination. If these chemicals are properly applied to turf at labelled rates, and no irrigation or rainfall occurs shortly after application, research has shown that they cause little environmental hazard.

Homeowners and urban chemical applicators can help protect our environment and minimize groundwater problems by adopting BMPs. Information outlining proper lawn and garden management techniques is available at your local Cooperative Extension office. The local Master Gardeners program also can help you determine how to properly fertilize and control pests.

Best Management Practices for Lawn and Garden Care

- **Apply all pesticides at the lowest effective labelled rate.**
- **Time chemical application for optimum effectiveness. Do not apply pesticide immediately prior to irrigation unless specified by the label.**
- **Apply only enough irrigation water to satisfy plant needs. Do not leach soils after pesticide or fertilizer application.**
- **Store all pesticides and fertilizers in a safe, dry place with the labels intact.**
- **Check with your county Department of Natural Resources prior to disposing of any lawn care chemical.**

Guidance Principle 2

Manage irrigation to minimize transport of chemicals, nutrients, or sediments from the soil surface or immediate crop root zone.

Irrigation water is the major transport mechanism for contaminants such as nitrate. Beneficial use of irrigation water implies keeping it free from pollutants that might affect quality. Methods to help minimize groundwater contamination due to deep percolation of water include:

- schedule irrigation according to crop needs and soil water depletion
- upgrade irrigation equipment to improve application efficiency
- time the leaching of soluble salts to coincide with periods of low residual soil nitrate
- reduce water application rates to ensure no runoff or deep percolation occurs during chemigation application.

Guidance Principle 3

Collect, store, and apply animal manures to land at agronomic rates to ensure maximum crop growth and economic return while protecting water quality.

In many cases, manures and other waste products are considered only from a waste management viewpoint, rather than as a sustainable source of plant nutrients. Groundwater monitoring data show that the aquifers around some feedlots are contaminated at levels above the EPA drinking water standard for nitrates. This is primarily due to improper application rates of manure on crop lands. To avoid this problem:

- analyze manures for nutrient content and percent dry matter
- reduce N fertilizer recommendations according to the amount of available N in the manure
- document that the land base for manure application is sufficient for the size of the animal feeding operation
- avoid manure applications on frozen or saturated soils and incorporate after application whenever feasible.

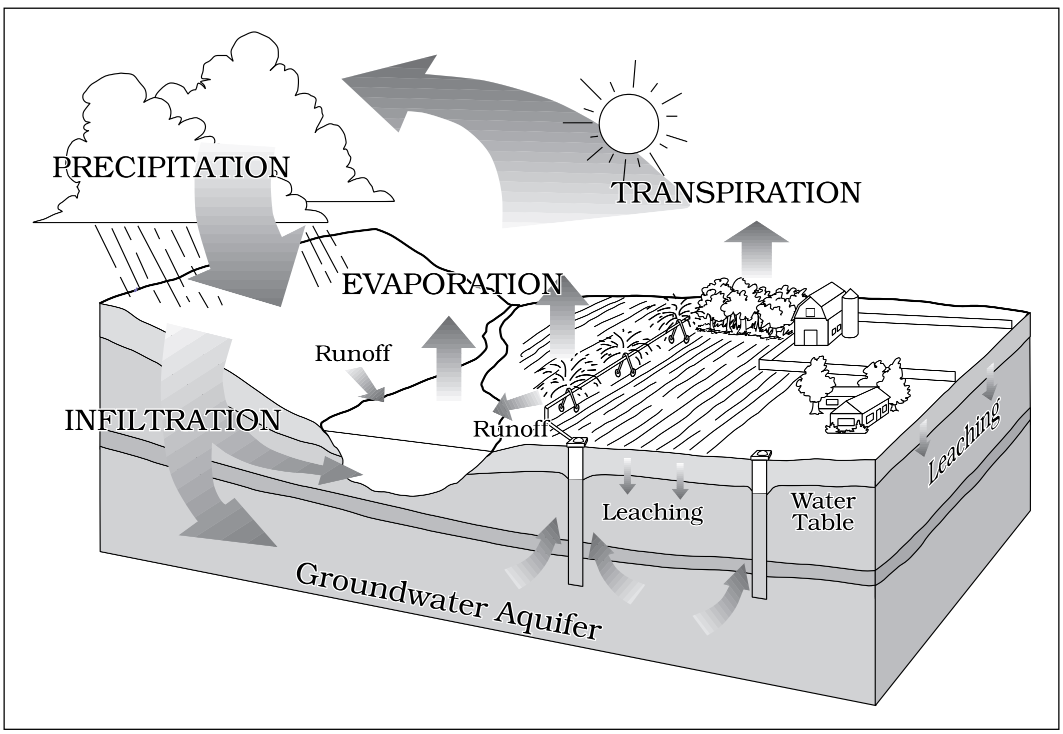


Figure 1. The hydrologic cycle

Guidance Principle 4

Manage phosphorus requirements for crop production to maximize crop growth and economic returns while minimizing degradation of water resources.

Phosphorus generally moves to water with eroded soil. In surface water, phosphorus can degrade water quality by causing accelerated eutrophication of lakes. High levels of N and P in water allow algae and aquatic plants to produce abnormally high amounts of biomass, which depletes oxygen and kills fish and other aquatic animals. Phosphorus from manure and commercial fertilizers can be prevented from entering surface waters by implementing standard SCS soil erosion practices and structures. Other BMPs for phosphorus include:

- sample the tillage layer of soil to determine available soil P levels and apply fertilizers according to soil test recommendations
- credit all available P from manures and other sources
- employ grass filter strips around erosive crop fields to catch and filter P in surface runoff
- incorporate surface applied P into the soil.

Guidance Principle 5

Use an Integrated Pest Management approach in pest control decisions.

Crop pests, such as insects, weeds, and plant diseases, cause millions of dollars in damage to Colorado crops each year. Pesticides often are used as the primary control method. Farmers and other land managers can save money and protect the environment by selecting a pest management strategy that reduces chemical use. Integrated Pest Management (IPM) combines chemical control with cultural and biological practices to form a single program for managing pests. It emphasizes maintaining pests below the economic threshold and using the minimum amount of chemical necessary for control. However, using the proper pesticide at the time of maximum pest susceptibility is critical to an effective IPM program.

IPM offers growers an array of tools to help manage pest problems. The foundation of this approach is a regular pest-monitoring program that enables producers to accurately determine when a pest control measure is economically justified. A sound pest program does not attempt to eradicate pests, but rather to manage them so that economic crop losses are minimized.

IPM 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
- spot treating or banding pesticides instead of broadcast treatments
- employing beneficial insects and other biological controls.

Reducing dependence upon chemical controls also decreases the probability of occupational health risks, reduces the chance of pest resistance, and increases consumer confidence in farmers.

Guidance Principle 6

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

Pesticide use is often necessary to achieve high levels of crop productivity and quality. Scientific data indicate that these products can be used safely if applicators follow the appropriate BMPs.

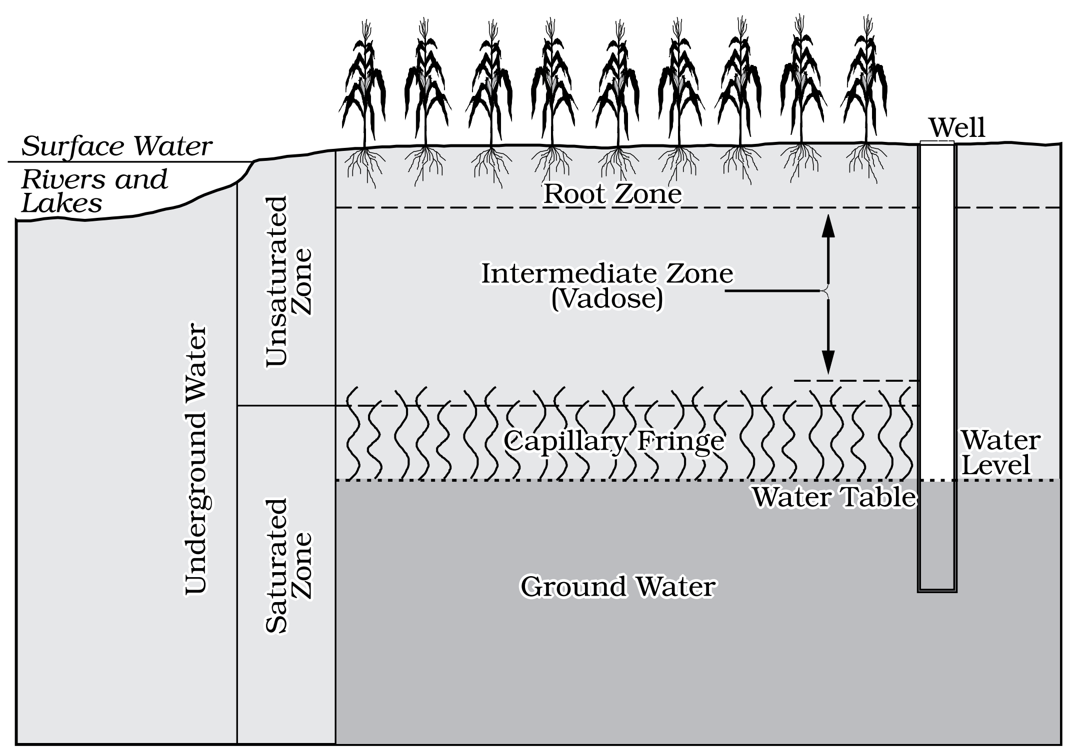
- All chemical applicators should receive thorough training and EPA certification prior to any use.
- Chemical applicators should know the characteristics of the application site, including soil type, depth to groundwater, and erosion potential.
- Chemical leaching hazard, persistence, and toxicity should be compared to site-specific conditions to determine suitability of the pesticide at that location.
- Application equipment should be inspected, calibrated, and maintained on a regular basis.
- Pesticide waste and storage should be minimized by purchasing and mixing only enough chemical to meet application needs. Using mini-bulk or refillable containers wherever possible minimizes container disposal problems.

Guidance Principle 7

Maintain records of all pesticides and fertilizers applied.

Keeping accurate records of all agricultural chemicals is a BMP that can save money and help you make informed management decisions. By law, records of all restricted-use pesticides must be maintained by operators for at least two years. Records of non-restricted chemicals can be maintained 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 should be kept on:

- irrigation water analysis
- subsoil nitrate
- crop yield goals and actual yields
- N fertilizer recommendation
- fertilizer and manure applied
- amount of water applied
- all pesticides applied, including brand name; formulation; EPA registration; amount and date applied; exact location of application; name, address, and certification number of applicator.



Guidance Principle 8

Facilities for pesticide and fertilizer storage, mixing, and loading should protect groundwater from contamination due to spills or leaks.

Spills, leaks, and backsiphoning into wells during chemical handling operations are thought to be responsible for most of the significant incidents of drinking water contamination by pesticides. Colorado Senate Bill 90-126 requires bulk storage facilities that annually handle more than 55,000 pounds (or 5,000 gallons) of bulk fertilizers or 3,000 pounds (or 500 gallons) of bulk formulated pesticide to meet specified requirements. These rules provide guidelines for bulk chemical storage, mixing/loading equipment, and mixing/loading pads. Even though not all chemical applicators fall under these regulations, the guidelines are BMPs for anyone who routinely handles pesticides or commercial fertilizers.

BMPs for storage and mixing facilities include:

- store all chemicals in a locked building with cement floors, located at least 100 feet from any water supply
- equip storage facilities with secondary containment dikes designed to contain liquid spills or leaks
- use impermeable mixing/loading pads at pesticide loading sites
- provide worker safety features such as showers, protective clothing, and spill cleanup kits
- make Material Safety Data Sheets available at the mixing station.

Guidance Principle 9

Protect wellheads from potential sources of contamination.

Wellheads can be very vulnerable sites for groundwater contamination because they are direct conduits to groundwater. Activities around the well, such as pesticide mixing and loading, represent a serious threat to drinking water supplies. BMPs for wellhead protection include:

- periodically inspect and maintain well construction as needed
- install backflow prevention devices
- stay at least 100 feet from the well when mixing, loading, and storing agricultural chemicals
- monitor well water quality periodically and know site-specific variables affecting aquifer vulnerability.

For more in-depth information or specific inquiries about Best Management Practices, check with Colorado State University Cooperative Extension. They have publications, programs, and specialists that can help you prevent water pollution.

Glossary

agricultural chemicals

Pesticides such as herbicides, fungicides, insecticides, rodenticides, and nematicides, as well as commercial fertilizers and plant growth regulators are considered agricultural chemicals, whether they are used in a rural or urban setting.

aquifer

A water-bearing layer of rock, sand, or gravel that will yield usable supplies of water.

background water quality

Pre-existing condition of a particular aquifer that has not been altered by human activities. Almost all groundwater contains some levels of natural contaminants such as sodium, nitrate, chloride, and others.

Best Management Practices (BMPs)

Recommended methods for preventing or reducing nonpoint source water pollution.

contaminant

Any physical chemical, biological, or radiological substance that degrades water quality.

eutrophication

Process where water resources become enriched with dissolved nutrients such as nitrogen and phosphorous, which may limit oxygen levels in the water.

groundwater

Water saturating subsurface formations or aquifers.

groundwater monitoring

Involves sampling and analyzing groundwater for various quality constituents.

hydrologic cycle

The dynamic movement of water through the environment in its various forms as driven by solar energy.

Integrated Pest Management (IPM)

A pest control strategy that uses chemical, biological, and cultural control methods as a single program.

leaching

The downward movement of dissolved or suspended minerals, fertilizers, agricultural chemicals, or other substances through the soil profile.

maximum contaminant level (MCL)

The highest amount of a specific contaminant allowed by the EPA in public drinking water supplies. These are health-based standards which by law must be set as close to the “no-risk” level as feasible.

nitrate (NO_3)

A form of nitrogen that is very soluble in water and may cause health problems if consumed in large amounts.

nonpoint source pollution

Water contamination from diffuse sources such as agricultural fields, urban runoff, or large construction sites.

parts per million (ppm)

A unit of proportion used to describe the concentration of a chemical in water, equivalent to milligrams per liter.

risk assessment

Determining the probability of injury, disease, or death from a specific source and weighing that probability against societal benefits.

vadose zone

The unsaturated soil or parent material below the crop root zone and above the water table.

water table

The upper boundary of the saturated zone of an aquifer.