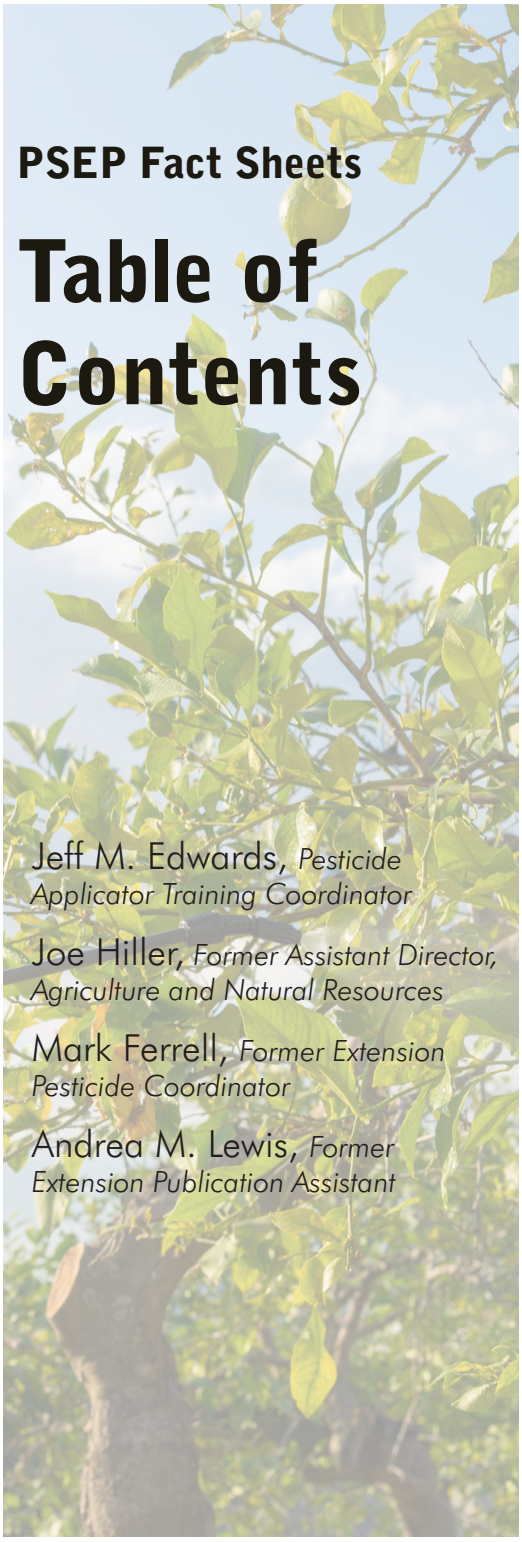
University of Wyoming Extension

Pesticide Safety Education Program

MP - 124 2013 Revised



PSEP Fact Sheets

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Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

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Appendix 1

Example Problems for Pesticide Applicator Exams

1 Pesticide Basics

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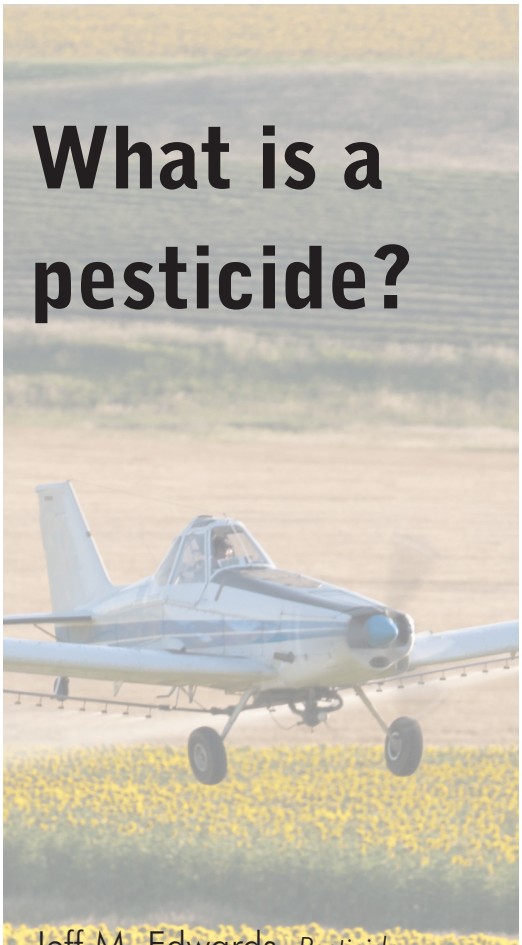
What is a pesticide?



Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

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University of Wyoming Extension

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What is a pesticide?

A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest. Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses. The term "pesticide" refers to any substance used to control pests (weeds, insects, and diseases). This includes all organic pest control methods. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

Many household products are pesticides. Did you know that all of these common products are considered pesticides?

- Cockroach sprays and baits
- Insect repellents for personal use
- Rat and other rodent poisons
- Flea and tick sprays, powders, and pet collars
- Kitchen, laundry, and bath disinfectants and sanitizers
- Products that kill mold and mildew
- Some lawn and garden products, such as weed killers
- Some swimming pool chemicals

By their very nature, most pesticides can create some risk of harm to humans, animals, or the environment because they are designed to kill or otherwise adversely affect living organisms. At the same time, pesticides are useful to society because of their abilities to kill potential disease-causing organisms and control insects, weeds, and other pests. In the United States, the Office of Pesticide Programs of the Environmental Protection Agency is chiefly responsible for regulating pesticides.

Biologically based pesticides, such as pheromones and microbial pesticides, are becoming increasingly popular and offer an increased level of safety to humans and the environment.

Here are some common kinds of pesticides and their functions:

Algaecides: control algae in lakes, canals, swimming pools, water tanks, and other sites.

Antifouling agents: kill or repel organisms that attach to underwater surfaces, such as boat bottoms.

Antimicrobials: kill microorganisms such as bacteria and viruses.

Attractants: attract pests by luring an insect or rodent to a trap. (However, food is not considered a pesticide when used as an attractant.)

Biocides: kill microorganisms.

Disinfectants and sanitizers: kill or inactivate disease-producing microorganisms on inanimate objects.

Fungicides: kill fungi (including blights, mildews, molds, and rusts).

Fumigants: Produce gases or vapors intended to destroy pests in buildings or soil.

Herbicides: kill weeds and other plants that grow where they are not wanted.

Insecticides: kill insects and other arthropods

Miticides (also called acaricides): kill mites that feed on plants and animals.

Microbial pesticides: microorganisms that kill, inhibit, or out compete pests, including insects or other microorganisms.

Molluscicides: kill snails and slugs.

Nematicides: kill nematodes (microscopic, worm-like organisms that feed on plant roots).

Ovicides: kill eggs of insects and mites.

Pheromones: biochemicals used to disrupt the mating behavior of insects.

Repellents: repel pests, including insects such as mosquitoes and birds.

Rodenticides: control mice and other rodents. The term pesticide also includes these substances.

Defoliants: cause leaves or other foliage to drop from a plant, usually to facilitate harvest.

Desiccants: promote drying of living tissues, such as unwanted plant tops.

Insect growth regulators: disrupt the molting, maturity from pupal stage to adult, or other life processes of insects.

Plant growth regulators: substances (excluding fertilizers or other plant nutrients) that alter the expected growth, flowering, or reproduction rate of plants.

What about pest control devices? EPA also has a role in regulating devices used to control pests. More specifically, a device is any instrument or contrivance (other than a firearm) intended for trapping, destroying, repelling, or mitigating any pest. A mousetrap is an example of a device. Unlike pesticides, EPA does not require devices to be registered with the agency. Devices, however, are subject to certain labeling, packaging, recordkeeping, and import/export requirements.

What is not a pesticide?

The U.S. definition of pesticides is quite broad, but it does have some exclusion -- drugs used to control diseases of humans or animals (such as livestock and pets) are not considered
pesticides; these drugs are regulated by the Food and Drug Administration.

Fertilizers, nutrients, and other substances used to promote plant survival and health are not considered plant growth regulators and thus are not pesticides.

Biological control agents, except for certain microorganisms, are exempted from regulation by the EPA. (Biological control agents include beneficial predators such as birds or ladybugs that eat insect pests.)

Finally, EPA has also exempted certain other low-risk substances, such as cedar chips, garlic, and mint oil.

The material for this factsheet was obtained from the United States Environmental Protection Agency from the Internet at the following location:

http://www.epa.gov/pesticides/whatis.htm Office of Pesticide Programs (7502C)

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PSEP Fact Sheet:

Wyoming's Pesticide Applicator Certification Program

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Individuals who apply restricted-use pesticides must be certified to do so under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the Wyoming Environmental Pesticide Control Act of 1973. Amendments to FIFRA require that applicators be continually recertified. Training is conducted by University of Wyoming Extension. Licensing is conferred by the Wyoming Department of Agriculture (WDA), which enforces FIFRA and the state act in Wyoming.

What are the different applicator classifications?

A **private pesticide applicator** is an individual 16 years of age or older who is licensed to apply or supervise the application of restricted-use pesticides to his or her own property, either owned or leased, or who may apply restricted-use pesticides for other individuals on their properties, owned or leased, either for no charge, or as an exchange of services, **but not for pay**, in the production of an agricultural commodity. Applicator classification is not related to either the amount of pesticides applied or to the amount of acreage treated.

A **commercial pesticide applicator** in Wyoming is a person 16 years of age or older who applies or supervises the application of any pesticide by other individuals, on property other than his or her own, **for contract or hire**. Commercial applicators are certified in one or more categories and may use pesticides only in the category(s) for which they are certified.

Private applicator certification is valid for five years, and the license expires on April 30 of the appropriate year. At the end of your five-year block, another block begins, and you must be recertified again during this block. This continues as long as you are a pesticide applicator. If you don't recertify you will not be able to purchase or apply restricted-use pesticides. Your county UW Extension office has information about becoming certified or to obtain training materials. Additional information is available on the University of Wyoming Pesticide Safety Education Program Website http://uwyoextension.org/psep/

Commercial applicator certification is valid for three years, and the license expires on January 31 of the appropriate year. Contact your county UW Extension office for information about becoming certified, recertifications or to obtain training materials.

How do I become recertified?

Private applicators have three options for recertification: 1) attending an Wyoming Department of Agriculture approved training session, 2) completing a home-study workbook, or 3) passing a written examination. Most private applicators choose to attend the training session. Contact your county UW Extension office for information about becoming recertified.

Commercial applicators also have three options for recertification: 1) attending an approved training session (those individuals whose licenses expire will be sent a notification of the time and location of an approved training session), 2) passing the appropriate category examinations, or 3) obtaining 24 hours of certification hours within their respective three-year block of time.

Certification hours are obtained at training sessions and relevant meetings. The Wyoming Department of Agriculture will assign hours to each approved training course; one hour will be assigned for each contact hour of relevant training. Relevance will be determined by the Wyoming Department of Agriculture.

What topics are included in the training?

Private applicator training program requirements:

- A minimum of two hours of training are required to certify Wyoming private applicators. The training session format is as follows:

    1. A verbal review of the certification requirements for Wyoming private pesticide applicators. An excellent review can be found in the Wyoming Department of Agriculture pamphlet "Certification of Applicators Who Use Restricted Use Pesticides." This pamphlet is available from the Wyoming Department of Agriculture.
    2. A verbal review of pesticide laws and regulations.
    3. Training on the use of pesticides including safety, worker protection, endangered species, handling, groundwater contamination, misuse, public concerns, and disposal.
    4. Training on proper use of pesticide equipment and calibration.

The balance of the training session is comprised of presentations chosen by the instructor. Electives may include such items as weed, insect, or disease control and could include presentations by specialists in the pesticide business such as extension personnel, weed and pest supervisors, or others involved with pesticides.

Commercial Applicator Training Program

Commercial Pesticide Applicator Training Short Course:

This is a multi-day course with training in pesticide labels and terminology, pesticide and farm worker safety, pesticide laws and regulations, pesticide toxicity, groundwater quality, pesticide formulations, plant pathology, weed science, entomology, small animal control, and calibration. One-half day extra is allowed for exams. The course uses instructors from the University of Wyoming, Environmental Protection Agency, Wyoming Department of Environmental Quality, and Wyoming Department of Agriculture.

Commercial Pesticide Applicator Recertification Short Course:

This is a multiple day course with information in the areas of laws and regulations, pesticide toxicity, vertebrate pest control, weed control, pesticide safety, integrated pest management, plant disease control, insect control, groundwater, and calibration. This course involves instructors from the University of Wyoming, EPA, Wyoming Department of Environmental Quality, and WDA. Held each year, this course is usually in January and usually in Casper.

Fees

The commercial license application fee is $25 upon successful completion of examination(s). There is a $25 renewal fee when requirements for recertification are met. There is no license application fee for government employees or private applicators.

Applicator (Private and Commercial) Training Fees

A registration fee is charged for the initial commercial applicator training session and for the commercial applicator recertification training session. There is no fee or registration charge for private applicator training.

What types of commercial licenses are available?

- **Cat. 901 Ag pest control** (Plant: weed, insect, and disease control), (animal pest control), (rodent control), (chemigation)
- **Cat. 902 Forest pest control**
- **Cat. 903 Ornamental and Turf pest control** (weed, insect, plant disease, rodent control)
- **Cat. 904 Seed Treatment**
- **Cat. 905 Aquatic pest control**
- **Cat. 906 Right-of-way pest control**
- **Cat. 907 Industrial, Institutional, Structural, and Health Related Pest Control (**bird control) **Cat. 908 Public Health pest control**
- **Cat. 909 Regulatory pest control** (rodent control, bird control, vertebrate pest control, M-44, livestock protection collars);
- **Cat. 910 Demonstration and Research Pest Control**
- **Cat. 911 Specific Use Pest Control** (wood preservation, non-government M-44, non-government livestock protection collar)
- **Cat. 912 Aerial Application**.

Commercial applicators should obtain licenses only in the categories in which they work. There are 12 major categories, and some of these categories have up to five subcategories. Call or write the WDA if unsure as to the category you need or for a copy of the Wyoming Applicator Certification Rules and Regulations. (Technical Services, WDA, 2219 Carey Ave, Cheyenne, WY 82002, (307) 777-6590.)

Additional information concerning Commercial and Private applicator certification, recertification, and training material can be found at www.uwyoextension.org/PSEP/

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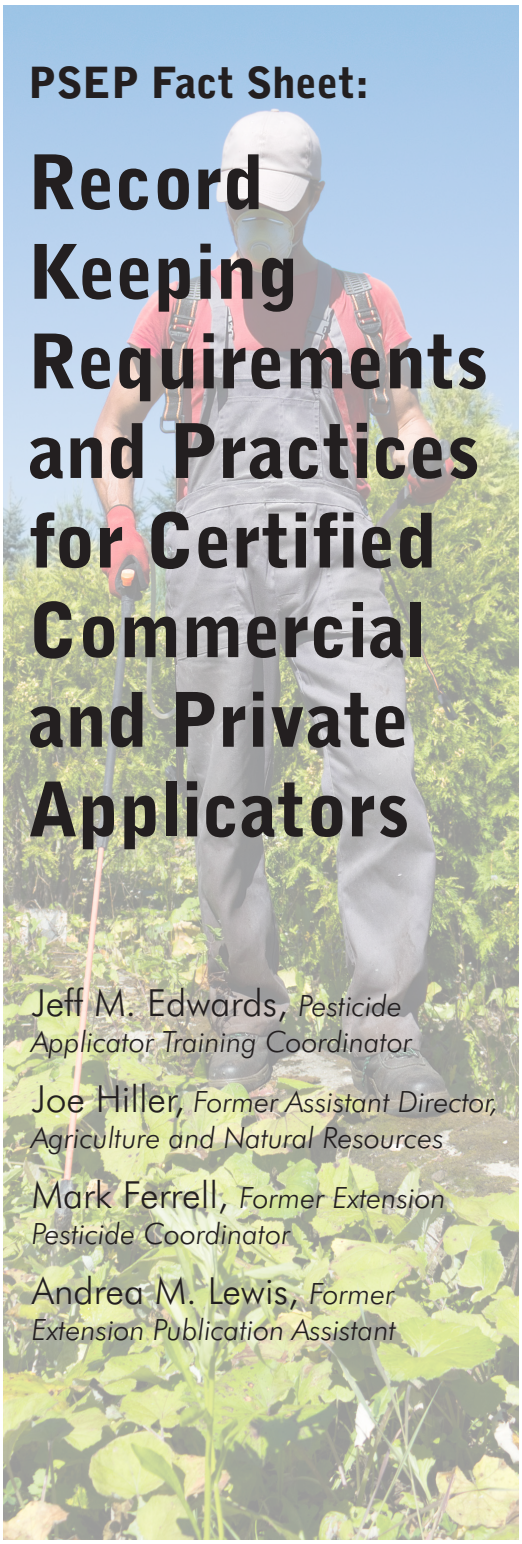
PSEP Fact Sheet:

Record Keeping Requirements and Practices for Certified Commercial and Private Applicators



Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

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University of Wyoming Extension

Department of Plant Sciences
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Applicators of Restricted-Use Pesticides Recordkeeping Requirements

The Agricultural Marketing Service of the U.S. Department of Agriculture has implemented the National Pesticide Recordkeeping Program as mandated by the 1990 Farm Bill. The Pesticide Records Branch has developed answers to the most frequent questions asked concerning the recordkeeping requirements. The attached questions and answers are provided to assist in clarifying the regulations.

Why were these regulations implemented for pesticide recordkeeping?

The 1990 Farm Bill or the Food, Agriculture, Conservation, and Trade Act of 1990, subtitle H, section 1491 states that the Secretary of Agriculture in consultation with the administrator of the Environmental Protection Agency (EPA) "shall require certified applicators of **restricted-use pesticides (RUPs)**… to maintain records comparable to records maintained by commercial applicators of pesticides in each state." Certified applicators include both commercial and private applicators. EPA currently requires certified commercial applicators to keep records under regulations implementing the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). EPA's regulations do not require certified private applicators to maintain records. However, some individual states including Wyoming does require certified private applicators to maintain records and has the authority to perform audits of your records.

What is the difference between a certified commercial applicator and a certified private applicator?

A certified **private** applicator is defined as one who uses or supervises the use of a RUP for the purpose of producing any agricultural commodity on property owned or rented by the applicator or if applied without compensation, other than trading of personal services between producers of agricultural commodities on the property of another person. A certified **commercial** applicator is defined as one who uses or supervises the use of a RUP on property other than their own and receive payment for application.

Some examples of commercial applicators certified under categories such as forest, demonstration and research, ornamental and turf, industrial, institutional, structural and health-related, right-of-way, and seed treatment.

What information would the certified applicator be required to maintain on a restricted-use pesticide?

The law requires you to record:

1. **The brand or product name of the restricted use pesticide and its EPA registration number.** (Federal law does not require that you record general use pesticide applications – only restricted-use pesticides.)
2. **The total amount applied**. Record the total quantity of product used – not the quantity after water or other substances were added. Amount does not refer to the percent of active ingredients. Use the pesticide labels for reference and record the amount in quantities similar to label language. For example, if the label states the pesticide is to be measured in pints or ounces, then record the amount in that measurement.
3. **The size of the area treated**. This information should be recorded in a unit of measure such as acre, linear feet, bushel, cubic feet, square feet, number of animals, etc. , which is normally expressed on the pesticide label in reference to the application being made. For special applications such as alternate middles, weed wicks, or bank application, record the total area covered. For example, if an 80–acre grove is treated using an alternate middle approach, the entire 80 acres would be recorded as the "size of area treated."
4. **The crop, commodity, stored product, or site** to which the pesticide was applied. Refer to the pesticide label for guidance if you are unsure how to record this information.
5. **The location of the application**. Record the location of the treated area, not the address of the farm or business. Your goal is to be able to identify the exact area of the application two years later if requested. The law allows any of the following designations: county, range, township, and section; maps or written descriptions; a USDA identification system such as those used by the Natural Resources Conservation Service or the Consolidated Farm Service Agency (formally SCS and ASCS), which involves maps and a numbering system to identify field locations; or the legal property description.
6. **The month, day, and year** of the application.
7. **The applicator's name and certification number**. If the application was made by someone who is not certified, then record the name and number of the certified applicator who supervised the application.

How to record spot applications

If you apply restricted-use pesticides on the same day in a total are of less than one-tenth of an acre, you are required to record only the following: brand or product name; EPA registration number; total amount applied; month, day, and year of the application; identification of the application as a spot application; and a general description of the location (for example, "treated ant mounds in the lower creek pasture") along with the words "spot application."

This spot application provision excludes greenhouse and nursery applications, which are required to keep all of the data elements.

Additional requirements

The information must be recorded within 14 days following the pesticide application. It will be easier to accurately record the data if you record it promptly.

You must keep records for two years from the date of the pesticide application. There is no required form. Any method (handwritten, typed, or computer generated) is acceptable as long as the required data is included.

Records by commercial applicators If you hire a commercial applicator, note that the regulations require commercial application record within 30 days of the application.

Access to the record information is limited to: USDA-authorized representatives who present identification; state-authorized representatives who present identification; and attending licensed healthcare professionals, or those acting under their direction, when treating individuals who may have been exposed to restricted-use pesticides.

Civil penalties

A certified applicator who violates any provision of the regulations will for the first offense be subject to a fine of not more than $500 or for subsequent offenses

be subject to a fine of not less than $1,000 for each violation. The penalty shall be less than $1,000 if the administrator of USDA Agricultural Marketing Service or his or her designee determines that the certified applicator made a good faith effort to comply.

Section 13. Reports and Records

Wyoming Statutes for Record Keeping

(a) Commercial applicators shall maintain and retain accurate and legible records of all pesticides applied during commercial applications for a period of two years.

(b) Certified commercial applicators who are involved in the commercial application of pesticides shall maintain office records giving such information with respect to:

- Name and address of person for whom the application was made, and if applicable, who purchased the pesticide(s)
- Location of the pesticide application
- Commodity or site treated
- Pest controlled
- Pesticide applied
- Brand name
- EPA registration number
- Amount of pesticide used
- Rate of application
- Method of application
- Date and time of application
- Weather conditions at the time of application
- Temperature
- Wind direction and velocity

Section 14. Required Practices for Commercial Applicators and Private Applicators

(a) Certified commercial applicators and private applicators shall notify the Wyoming Department of Agriculture of any change of business address within seven days.

(b) Prior to application shall inform the customer of the following items:

1. Pesticide(s) applied
2. Possible residue hazards
3. Any restricted entry periods
4. Any waiting periods prior to harvest
5. Application dates and times
6. Post-application label safety precautions
7. Other applicable label requirements (posting, worker protection)

Material taken from: Wyoming Applicator Certification Rules and Regulations. A complete set of rules and regulations is available from the Wyoming Department of Agriculture, 2219 Carey Avenue, Cheyenne, WY 82002- 0100.

For additional information

You may obtain information on the Pesticide Record Keeping Programs website at www.ams.usda.gov/pesticiderecords. In addition, you may send questions/comments via email to amspesticide.records@usda.gov or written questions/comments to USDA/AMS/Pesticide Records Branch, 8606 Sudley Road, Suite 203, Manassas, VA 20110-4582.

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Private Applicator Record of Restricted-Use Pesticides
(Retain record for two years after application)

If spot treatment (less than 1/10 acre) application is made, write "spot" in "field size".

Name of Applicator _____ Applicator certification # _____

Application date _____ Crop, commodity or site protected _____

Pesticide brand/product name _____ Pesticide EPA registration # _____

Total amount of restricted use pesticide applied _____ Field size _____

Restricted-entry interval (REI) _____

Field location (choose one of four below):

_____ County/range/township/section _____

_____ ASCS/SCS ID system _____

_____ Legal property description _____

_____ ID system using map and/or written description _____

Field Map

Notes _____

_____

_____

_____

Application starting time _____ Temperature _____

Crop stage of growth _____ Wind direction and speed _____

Target pest _____ Soil conditions (wet, dry, cloddy, etc.) _____

Pest stage of growth _____ Relative humidity (low, med., high) _____

Records of restricted-use pesticide applications can be kept in any format. They may be handwritten on individual notes or forms, consist of invoices, are computerized, and/or are maintained in record keeping books. Certified commercial applicators must provide their records of a restricted-use pesticide application within 30 days to the person for whom such an application was provided. They may provide a copy of records required by this Federal Register notice or a copy of their State/Federal record.

Source: Pesticide Education Office, University of Nebraska-Lincoln

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PSEP Fact Sheet:

Agricultural Worker Protection Standard for Agricultural Pesticides

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

The EPA has issued regulations for the Worker Protection Standard (WPS) for agricultural pesticides. The regulations expand the requirements for warnings about agricultural pesticide applications, use of personal protective equipment, and restrictions on entry to treated areas and add provisions for decontamination, emergency assistance, maintaining contact with handlers of highly toxic agricultural pesticides, and agricultural pesticide safety training.

Agricultural pesticide registrants are required to include appropriate labeling statements referencing these regulations and specifying application restrictions, restricted-entry intervals (REIs), personal protective equipment (PPE), and notification to workers about agricultural pesticide applications.

The WPS is directed toward the working conditions of two types of employees:

- agricultural pesticide handlers — those who handle agricultural pesticides or application equipment (mix, load, apply, clean, repair, flag, etc.) and
- agricultural workers — those who perform tasks related to the cultivation and harvesting of plants on farms or in greenhouses, nurseries, or forests.

There are three types of provisions intended to:

1. eliminate or reduce agricultural pesticide exposures,
2. mitigate exposures that occur, and
3. inform employees about the hazards of agricultural pesticides.

1. **Eliminate or reduce agricultural pesticide exposures.** This rule limits agricultural pesticide exposures by REIs for all agricultural pesticide products that are used in the production of agricultural plants. The REI is the period of time after the application of an agricultural pesticide during which worker entry into a treated area is restricted. Early entry requires the use of label-specified PPE.
   - **48-hour REIs** are established for any agricultural product that is highly toxic because of dermal toxicity or skin or eye irritation. (The REI is extended to 72 hours in arid areas for agricultural organophosphate insecticides applied outdoors.)
   - **24-hour REIs** are established for any agricultural product that is moderately toxic because of dermal toxicity or skin or eye irritation.
   - **12-hour REIs** are established for any agricultural product that is slightly toxic because of dermal toxicity or skin or eye irritation.
   - **4-hour REIs** are established for any low-risk agricultural products.

- **Previously established REIs** will be retained if they are longer than the REI established by these rules.

Overall exposure to agricultural pesticides is reduced in this rule by:

- prohibiting agricultural pesticide application in a manner that will expose workers or others,
- excluding workers from areas being treated with agricultural pesticides,
- excluding workers from areas that remain under an REI with narrow exceptions,
- protecting early-entry workers who are performing permitted activities in treated areas during an REI including special instructions and duties related to correct use of PPE,
- notifying workers about treated areas so they can avoid inadvertent exposures, and
- protecting handlers during handling activities including monitoring while handling highly toxic agricultural pesticides and duties related to correct use of PPE.

2. Mitigate exposures that occur

- Decontamination procedures require providing handlers and workers an ample supply of water, soap, and towels for routine washing and emergency decontamination.
- Emergency procedures require making transportation available to a medical care facility if an agricultural worker or handler may have been poisoned or injured by an agricultural pesticide and providing information about the agricultural pesticide(s) to which a worker or handler may have been exposed.

3. Inform employees about the hazards of agricultural pesticides

- Agricultural pesticide safety training requires training for workers and handlers.
- Agricultural pesticide safety training requires the posting of an agricultural pesticide safety poster.
- Access to labeling information requires that agricultural pesticide handlers and early-entry workers are informed about agricultural pesticide label safety information.
- Access to specific information requires a centrally located listing of agricultural pesticide applications at the establishment.

Implementation

WPS requirements on agricultural pesticide labels include:

1. using label-specified PPE,
2. obeying label-specified requirements to provide oral warnings and to post-treated areas,
3. obeying label-specified restrictions on entry to treated areas during REIs,
4. providing training of workers and handlers,
5. providing certain notification and information,
6. providing decontamination supplies, and
7. providing emergency assistance.

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PSEP Fact Sheet:

Worker Protection Standard- Record Keeping Requirements

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

USDA Recordkeeping Manual for Private Pesticide Applicators

This manual contains forms that will help you keep the records required by Federal and State regulations for restricted use pesticides and for compliance with the EPA Worker Protection Standard. These forms are intended for use by private pesticide applicators. They are not intended for use by applicators licensed as commercial pesticide applicators.

These forms are designed for your convenience. The information you write here becomes the official record for your compliance with the law. If you use a sharp, dark pencil to write on the forms, your marks are less likely to be destroyed by rain, coffee spills, or other accidents. Please write clearly so that those who inspect your records can easily understand them.

You may keep your records in other ways as long as they contain the required information. Either handwritten notes, computer-generated records, or other recordkeeping systems are acceptable. The forms in this manual are also available from the following Internet Web site: http://www.ams.usda.gov/pesticiderecords

Recordkeeping Requirements for Restricted Use Pesticides

The 1990 Farm Bill requires private certified pesticide applicators to keep records of all applications of federally restricted use pesticides. The U.S. Department of Agriculture's (USDA) Agricultural Marketing Service carries out the provisions of the Federal recordkeeping requirements. The information required by the Federal legislation is shown on page 9. These records must be kept for two years; however, you may want to keep them longer for reference in making future management decisions.

Although applicators have 14 days to record information related to applications, it is a good idea to fill out the recordkeeping form immediately after application to be sure that you have an accurate and detailed record.

If you hire a commercial applicator to apply a restricted use pesticide, you should obtain the necessary recordkeeping information from the applicator. Commercial applicators are required to provide their clients with a copy of the record within 30 days of application. Application information is also required for areas receiving spot treatments.

On the record form "USDA" will appear under each column heading that is required by the Federal pesticide recordkeeping regulations.

Who Has Access to Your Records?

Your records can be inspected at any time by authorized representatives of the U.S. Department of Agriculture and State pesticide regulatory agencies who present identification. In addition, a licensed health-care professional, or someone working under a licensed health-care professional's supervision, can request the record information at any time following an application when treating individuals who may have been exposed to restricted use pesticides.

Benefits of Keeping Records

The records you keep on pesticide use are not only required by the law, they will also help you improve your farming operation.

- Records help you evaluate how well a chemical worked, particularly if you have used reduced rates or alternative application techniques.
- Records help you figure out how much pesticide you will need in a future year, so that you will not have to store or dispose of extra chemicals.
- Records help to prevent carry-over injury and improve rotation decisions.
- Records may protect you from legal action if you are accused of improper pesticide use.
- Food processors may require pesticide records to evaluate the potential for residues.
- Lenders and land developers often require records to evaluate potential environmental liability before lending money or buying land.
- Records provide data to respond to surveys conducted by Federal agencies and universities that can impact future availability of some pesticides through re-registration. They may also be used to respond to the public's concern regarding pesticide use.
- Records can save money by helping a farmer determine the best pesticide management program. Records are the key to a successful integrated pest management program.

Enforcement and Penalties

USDA's Agricultural Marketing Service (AMS) administers the Federal recordkeeping regulations. The AMS Administrator is responsible for the enforcement actions taken against violators of this standard. Any private applicator who violates the recordkeeping requirements of the USDA shall be liable for a civil penalty of not more than $750 for the first offense and not less than $1,100 for any subsequent offense.

What's in the Rest of the Manual?

- Summary table of pesticide recordkeeping requirements.
- Forms to record your pesticide applications.
- Sample sprayer calibration log form.
- Six-year calendar.

Recordkeeping Information for the EPA Worker Protection Standard

The EPA Worker Protection Standard (WPS) is a Federal regulation that is intended to reduce the risk of pesticide poisoning and injury among agricultural workers. Private applicators who hire pesticide handlers and/or workers must display application information in a centrally located area accessible to all employees before a pesticide is applied. This display of information applies to all pesticides with "Agricultural Use Requirements" printed on the label, not just restricted use pesticides.

The Hand/Head Keep Out (right) symbol appears in the column headings on the record sheets to mark information required for worker protection. This includes the location and crop/commodity treated; brand name; EPA registration number; active ingredients of pesticide applied; the month, day, year, and time of application; and the Restricted Entry Interval (REI). Most of this information can be found on the pesticide label. Workers, handlers, government officials, health care workers, and employers of commercial handlers hired to work on the farm or business must have access to this information. Commercial applicators must provide this information to the agricultural employer before making pesticide applications. Information must be displayed for 30 days after the end of the REI. If there is no REI on the label, the information should be displayed for 30 days after the application.

USDA Recordkeeping Manual for Private Pesticide Applicators

Grower/Applicator Information

Owner/Operator _____

Address _____

Company/Farm Name _____

Phone Number _____

Phone Number _____

Applicator Name	Certification Number
A. _____	_____
B. _____	_____
C. _____	_____
D. _____	_____
E. _____	_____
F. _____	_____
G. _____	_____
H. _____	_____

SAVE TIME: The Federal recordkeeping regulations require the certified private applicator to record the brand/product name and the U.S. Environmental Protection Agency (EPA) registration number of the federally restricted-use pesticide (RUP) he/she applies. The Federal recordkeeping regulations do not require the certified private applicator to record active ingredient(s). You will be able to save time by listing the brand/product name, EPA registration number, and active ingredient(s) of the pesticides you apply on this page and then entering the corresponding number(s) to complete your record form. Use of this page is voluntary.

Brand/Product Name	EPA Registration Number	Active Ingredient(s)
1) _____	1) _____	1) _____
		1a) _____
		1b) _____
2) _____	2) _____	2) _____
		2a) _____
		2b) _____
3) _____	3) _____	3) _____
		3a) _____
		3b) _____
4) _____	4) _____	4) _____
		4a) _____
		4b) _____
5) _____	5) _____	5) _____
		5a) _____
		5b) _____
6) _____	6) _____	6) _____
		6a) _____
		6b) _____
7) _____	7) _____	7) _____
		7a) _____
		7b) _____
8) _____	8) _____	8)_____
		8a) _____
		8b) _____

Brand/Product Name	EPA Registration Number	Active Ingredient(s)
9) _____	9) _____	9) _____
		9a) _____
		9b) _____
10) _____	10) _____	10) _____
		10a) _____
		10b) _____
11) _____	11) _____	11)_____
		11a) _____
		11b) _____
12) _____	12) _____	12) _____
		12a) _____
		12b) _____
13) _____	13) _____	13) _____
		13a) _____
		13b) _____
14) _____	14) _____	14) _____
		14a) _____
		14b) _____
15) _____	15) _____	15) _____
		15a) _____
		15b) _____

QUICK REFERENCE CHART OF PESTICIDE RECORDKEEPING REQUIREMENTS FOR USDA AND EPA FEDERAL REGULATIONS

	Restricted Use Pesticides	**Agricultural Use Pesticides**
Required Items	USDA Requirements for Private Applicators	Worker Protection Standard Requirements for Agricultural Employers
Brand Name/Product Name		
EPA Registration Number		
Total Amount of Pesticide Applied		
MM/DD/YYYY		
Field ID/Location of Treated Area		
Crop, Commodity, or Site		
Size of Area Treated		
Name of Certified Applicator		
Applicator Certification Number		
Active Ingredients		
Restricted Entry Interval (REI)		
Completed Record	Within 14 days of the application; legible records must be recorded and kept for two years.	Post before application, information should be kept 30 days after the REI expiration.

How To Complete the Pesticide Application Record Form

- **"USDA" will appear under each column heading that is required by the Federal pesticide recordkeeping regulations.**
- The information in columns marked with the Hand/Head Keep Out symbol must be provided to field workers/handlers for all pesticides with "Agricultural Use Requirements" on the label to meet the WPS requirement. This information must be posted before application and remain for 30 days after the end of the REI for the WPS requirement.

FIELD ID/LOCATION "USDA"

Applicator Name and Certification Number "USDA"	MO/Day/ Year Time "USDA"	EPA Reg. Number "USDA"	Active Ingredients	Brand/Product Name "USDA"	Restricted Entry Interval (REI)	Crop, Commodity or Site "USDA"
Bob B. Smith 200029265	5-3-02 10am*	241-337	Pendimethalin	Prowl 3.3EC	24 hrs.	Cotton
	5-3-02 10am*	100-642	Fluometuron	Cotoran 4L		
2.	3.	4.	5.	6.	7.	8.

*Time is not required by the USDA pesticide recordkeeping regulations, but it is required by the WPS.

1. 52-48 Old Creek Field
2. Write the **location of the application** (not the farm or business). The location may be identified on a farm map, by USDA map and number, by Global Positioning System (GPS), by a common field name (for example, 52- 48 Old Creek Field), or by a legal description. If the site treated is a greenhouse or storage facility, give it a unique name or number. If you use GPS coordinates to record location you can: (a) Create a map of the treated area with GPS coordinates, (b) List the GPS coordinates to delineate the field perimeter, or (c) Record GPS coordinates that accurately identify one point pertaining to the field. The coordinates should be followed by a statement indicating the relationship of the point to the field. For more information on GPS go to: www.ams.usda.gov/pesticiderecords
3. If the **name** and **certification number** are the same as the name and certification number of the person on the applicator information form on page 3, then you may record the letter listed for the applicator. If anyone else is applying the pesticide, record the applicator's name and certification number.
4. Fill in the **month, day, and year** of application. WPS also requires you to post the time of application, so record time here as well.
5. The **EPA Registration Number** is located below the ingredients statement on most labels (for example, EPA Reg. No. 241-337). It is not the same as the EPA establishment number. If you completed page 4 through 6 as suggested, you may write the appropriate number in space 4.
6. Copy the **active ingredients** from the label for all products used in the application. If you completed page 4 through 6 as suggested, you may write the appropriate number in space 5.
7. Write the **brand** or **product name** of the pesticide. Multiple lines may be used to record tank mixes. Information on all products used in a tank mix is required. If you completed pages 4 through 6 as suggested, you may write the appropriate number in space 6.
8. The pesticide label lists the **Restricted Entry Interval**. The application information for workers must remain posted until 30 days after the end of the REI. When there is no REI, the notice must remain for 30 days after the application date. If you apply pesticides in a tank mix with different REI's, write down the longer REI.
9. Fill in the **crop, commodity, or site**. If the location is a greenhouse, record crop and site location. If you are treating livestock, record the type of animals treated (hogs, cattle, etc.).
10. The pesticide label will usually give you a minimum to maximum of the application **rate** per unit (for example, 1.5 pints per acre) . Record the rate you actually use.
11. Record the number of **units treated**. This may be acres, linear feet, bushels, cubic feet, square feet, or number of animals, etc. For special applications (for example, alternate middles, weed wicks, band applications) re-

cord the total area covered. A 20-acre field treated using an alternate middle approach would still be recorded as 20 acres. See note on spot treatments below.

12. The **total amount applied** refers to the total quantity of product used—not the quantity after water or carrier is added. Amount does not refer to percent of actual ingredient.
13. When you are filling out the application record, you may find it helpful to record information about the sprayer equipment, the pests, the weather (particularly wind speed and direction, but also temperature and humidity), and the crop status. This will help you know whether an application was effective and improve future pest-management decisions. It will also be helpful in problem solving if the pesticide fails to control the target pest or moves off target.

Rate	**Size of Area Treated "USDA"**	**Total Amount Applied "USDA"**	**Field notes: target pest(s); sprayer nozzles, speed, pressure, gallonage; wind& weather; crop status**
1.5 pints per acre	20 acres	3.75 gallons	Sunny, wind speed 3-5 mph. Light grass infestation Gallonage = 10 gallons per acre. Banded at planting.
2 quarts per acre	20 acres	10 gallons	
9.	**10.**	**11.**	**12.**

Note: "Spot Treatments" are applications made to less than one-tenth of an acre. Application of a RUP herbicide along a fence row or an insecticide applied to a fire ant mound would be examples of spot treatments. (Note: Greenhouse and nursery treatments do not qualify as spot treatments.) For spot treatments, describe location of area treated (for example, poison ivy along fence row of Baker Farm), indicate "spot treatment," and record:

- Brand name.
- EPA registration number.
- Month, day, and year.
- Total amount applied.
- "Spot treatment" describes location.

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FIELD ID/LOCATION "USDA" :

Applicator Name and Certification Number "USDA"	MO/ Day/Year Time "USDA"	EPA Reg. Number "USDA"	Active Ingredients	Brand/ Product Name "USDA"	Restricted Entry Interval (REI) USDA	Crop, Commodity, or Site "USDA"

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PSEP Fact Sheet:

Pesticide Labeling

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), as amended, requires that certain information accompany a pesticide. The information printed on or attached to a container is the label. Each time you purchase a pesticide, you also may receive additional instructions about how to use it. This printed information about the pesticide product from the company or its agent is called labeling. Labeling includes such things as the label on the product, brochures, flyers, and information distributed by the dealer. To the manufacturer, the label is a license to sell. The state or federal government uses it as a way to control the distribution, storage, sale, use, and disposal of the product. The buyer or user sees the label as the primary source of information about how to use the product safely, correctly, and legally. The label is a source of information on proper treatment for poisoning cases to physicians.

Information on the label is the result of many years of extensive research and development that has cost millions of dollars. This provision is made for the protection of humans, plants, animals, and the environment. Reading the label thoroughly before using any pesticide cannot be stressed too much. It is a prescription for use.

Parts of the Label

The label, by law (FIFRA), must include the following information:

1. Brand and chemical name of the product
2. Manufacturer's name and address
3. EPA registration and establishment number
4. Net contents
5. Ingredients statement
6. Kind of formulation
7. Registered uses
8. PPE – Personal Protective Equipment
9. WPS – Workers Protection Standards
10. Endangered species concerns
11. Hazard statements – toxicity categories
12. Directions for use
13. Storage and disposal precautions.

Brand and Chemical Name

The brand or trade name identifies a product of a specific company. It appears on the label on the front panel in large, bold print, and it is the most identifiable name of the product. The common name of the product is a name given to a complex chemical name. For instance, Tordon is the brand name of the herbicide picloram, which is the common name.

The chemical name is 4-amino-3,5,6-tricholorpicolinic acid. A pesticide made by more than one company is sold under several brand names, but all of them have the same common name or chemical name.

Manufacturer's Name and Address

The law requires that the product's maker or distributor put the company's name and address on the label so you will know who made or sold the product.

Registration and Establishment Number

A registration number must be on every pesticide label. An EPA number shows that the product has been registered with the federal government. It usually is found on the front panel of the label and is written as "EPA Registration No. 0000." A number assigned to the establishment where the product is manufactured must also appear. In cases of special local needs, pesticide products may be approved by a state. These registrations are designated, for example, as EPA SLN No. WY-80004. In this case, SLN indicates "special local need." Wyoming-800004 means the product is registered for use in Wyoming, was registered in 1980, and was the fourth special needs product registered in the state that year.

Net Contents

The net contents number tells you how much is in the container. If the product is liquid, it must be stated in liquid measure terms (gallons, quarts, pints, and fluid ounces). If the product is a powder or granule, it is stated in terms of weight (pounds and ounces).

Ingredient Statement

Every pesticide label must list what is in the product. The amount of each active ingredient is given as a percentage by weight and as pounds per gallon of concentrate. It can be listed by either the chemical name or the common name. The inert ingredients need not be named, but the label must show what percent of the contents they make up.

Kind of Formulations

The basic chemical used to control pests must be formulated with other materials such as solvents, emulsifiers, surfactants, powders, granules, and dusts. The formulation is listed on the label as an emulsifiable concentrate, wettable powder, granules, fumigant, and so on. The same pesticide may be available in more than one formulation. Formulations, for example, may be designated on the label as 7E (7 pounds per gallon emulsifiable liquid), 50-WP (50 percent wettable powder) or 10-G (10 percent granular).

Registered Uses

The label must include what specific pests the pesticide controls, what crop or animals it can be used on, and the classification of uses. Every pesticide label must show whether the contents are for general use or restricted use. The pesticide's classification depends on its toxicity (hazard of poisoning), the way in which it is used, and its effect on the environment.

General-use pesticides may be applied by the general public without restrictions, other than those specified on the label.

Restricted-use pesticides require controls in addition to label instructions because they may have unreasonable adverse effects on the environment or injure the applicator; even when applied in accordance with directions for use, warnings, and cations; or when used in accordance with a widespread or commonly recognized practice. Labels for restricted-use products must state at the top of the front panel, "Restricted-use pesticides for retail sale to and application only by certified applicators or persons under their direct supervision."

Hazard Statements

All pesticide labels must have the statement, "Keep Out of the Reach of Children." They are grouped according to their toxicity to people, animals, and the environment. You can determine the toxicity of a product by reading the signal word and looking at the symbol on the label.

Group	Signal Word	Toxicity	Approximate amount to kill an average person
I	Danger-Poison	Highly toxic	Taste to teaspoon
II	Warning	Moderately toxic	Teaspoon to tablespoon
III	Caution	Slightly toxic	Ounce to one pint

Highly toxic materials have skull and crossbones symbol plus the signal word "Danger" and the word "Poison." Warning statements appear on the label if the product can poison humans and animals. The label also tells you of any special steps you should take to avoid poisoning, such as the kind of protective equipment needed.

Precautionary statements are on the label to protect the environment from pesticide contamination. For example, products toxic to bees will carry a warning statement on exposure from direct treatment or residue in crops. Warning statements also appear on the label to prevent people from contaminating water by cleaning their equipment, disposing of wastes, or applying pesticides where runoff is likely to occur. Statements also appear to remind the pesticide user against harming birds, fish, and wildlife.

Highly toxic pesticides must have appropriate warning statements about symptoms or poisoning if the product is swallowed or inhaled. Information on antidotes and instructions to call a physician in an emergency will be included. A warning statement also must appear if the product can irritate the skin, nose, throat, or eyes.

Directions for Use

Pesticide labels must include instructions on how to use the pesticide and must be adequate to protect the user and the public. The use instructions should indicate how to apply the product correctly, when the product can be applied, and at what rate it should be applied. If required for the product, the label should indicate the Pre-Harvest Interval (PHI) – the number of days between treatment and harvest – and re-entry interval (REI), the amount of time that must pass before a person can safely enter a pesticide-treated area without personal protective equipment (PPE).

The label states that it is a violation of federal law to use a pesticide and must be adequate to protect the user and the public. The use instructions should indicate how to apply the product correctly, when the product can be applied, and at what rate it should be applied. If required for the product, the label should indicate the waiting period – the number of days between treatment and harvest – and re-entry, the amount of time that must pass before a person can safely enter a pesticide-treated area without protective clothing.

The label states that it is a violation of federal law to use a product in a manner inconsistent with its directions. It is illegal to apply a pesticide to a crop or site not listed on the label. If applied to a pest not included on the label, the applicator is responsible for the results of that application. Some pesticide labels indicate use is limited to certain categories of commercial applicators.

Some directions for use that pesticide users must obey are contained in documents that are only referred to on the labeling. Such instructions include EPA or other government regulations or requirements concerning the safe use of the pesticide product. EPA has adopted new requirements concerning: groundwater protection; endangered species protection; pesticide transportation, storage, and disposal; and worker protection. One sentence or paragraph may be the only notice you will receive that additional use directions are required for the product to be used in compliance with its labeling. You must deter-

mine whether you are affected, locate the applicable directions for use, determine how to comply with the instructions and requirements in the directions for use, and comply with those instructions and requirements.

Storage and Disposal Precautions

The label has directions for storing the pesticide to prevent contamination of other products. Storage temperatures are stated on the label to prevent overheating or freezing.

The label either explains procedures for disposing empty containers or tells the user to follow procedures designated by state law. Directions on how to dispose of water when rinsing equipment and containers also are included.

Reading the Label

Before you buy a pesticide, read the label to determine:

- Whether it is the pesticide you need for the specific crop and pest
- Whether the pesticide can be used safely under the application conditions

Before you mix the pesticide, read the label and understand:

- What personal protective equipment (PPE) should be worn
- What the pesticide can be mixed with (compatibility)
- How much pesticide to use
- The mixing procedure

Before you apply the pesticide, read the label to determine:

- What safety measures you should follow
- Whether protective clothing and equipment are needed
- Where the pesticide can be used (livestock, crops, structures, as examples)
- When to apply the pesticide (including the waiting period for crops and animals)
- How to apply the pesticide
- Whether there are any restrictions for use of the pesticide

Before you store or dispose of the pesticide or pesticide container, read the label to determine:

- Where and how to store the pesticide
- How to decontaminate and dispose of the pesticide container
- Where to dispose of surplus pesticides

If you have trouble reading or understanding the pesticide labeling, contact your local county extension office or other knowledgeable person.

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PSEP Fact Sheet:

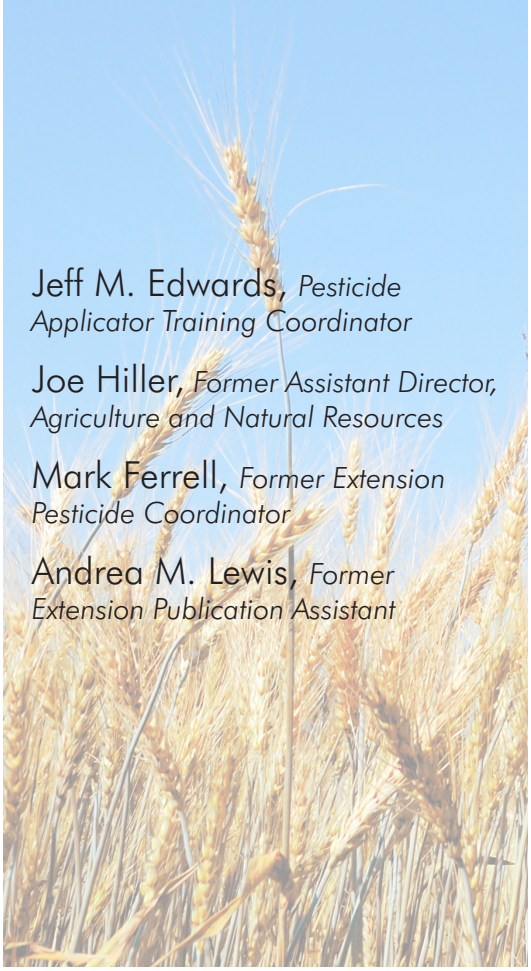
Pesticide Formulations

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*



University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

The **active ingredient** (a.i.) is the agent in a formulation which has a specific effect on a pest, weed, or disease. A single active ingredient often is sold in several different formulations. In making a choice of which formulation will be best for each use, consider the:

- Plant, animal, or surface to be protected
- Application machinery available and best-suited for the job
- Hazard of drift and runoff
- Safety to applicator, helpers, other humans, and pets likely to be exposed
- Habits or growth patterns of the pest
- Cost
- Type of environment in which the application will be made

The amount of active ingredient (a.i.) and the kind of formulation are listed on pesticide labels. For example, a 50W contains 50 percent by weight of a.i. and is a wettable powder. If it is a 10 lb bag, it contains 5 lb of a.i. and 5 lb of other ingredients. Liquid formulations indicate the amount of a.i. in pounds per gallon. For example, a 4E means 4 lb per gallon of the a.i. in an emulsifiable concentrate formulation.

Types of Formulations

Aerosol - Either ready-to-use type such as household sprays or smoke or fog generators that break the liquid formulation into a fine mist or fog using a rapidly whirling disc or a heated surface.

Baits - Incorporate some sort of pest attractant. Baits are commonly used to control rodents, cockroaches, and ants.

Dry Flowable - DF - Also known as water-dispersible granules (WDG). The a.i. is formulated on a granule. They form a suspension when mixed with water and require less agitation than wettable powders.

Dust - D - Formulations of pesticides on a dry particle that are designed to be applied dry. Formerly widely used, few dust formulations are made today. Problems include difficulties in applying with modern equipment, excessive drift, increased hazards to honeybees, and applicator inhalation problems.

Emulsifiable Concentrate - EC or E - A liquid formulation of pesticide containing the a.i., one or more solvents, and an emulsifier that allows mixing with water.

Flowable - F or FL - A liquid formulation consisting of a finely ground a.i. suspended in a liquid and mixed with water for application.

Granule - G - Dry formulations mixed onto fairly large particles of clay, ground corn cob or walnut hulls, or manufactured

granules. They are applied as formulated, without mixing. Most granules are made by spraying the pesticide onto the carrier particle, although some are "built" into the granule.

Low Concentrate Solution - Small amounts of a.i., one percent or less, used without dilution for structural pests, space sprays in barns, mosquito control, etc.

Microencapsulation - Particles of a pesticide, either liquid or dry, surrounded by a plastic coating, mixed with water and applied as a spray. Encapsulation makes timed release possible; however, they are often somewhat more expensive and can increase hazards to honeybees.

Soluble Powder - SP - A dry formulation which, when mixed with water, dissolves readily and forms a true solution. When thoroughly mixed, no agitation is necessary.

Solution - S - A dry formulation of pesticide that will go into true solution when mixed with water. Relatively few pesticides are water soluble. These pesticides may also be formulated as liquids.

Tracking powders - Primarily used to control insects and rodents found in homes and other structures. They are applied to areas where the pests tend to travel. After they are picked up, the powder is often ingested as the animal grooms itself. Silica aerosols placed in wall voids for cockroach control and boric acid placed along routes traveled by ants are examples of tracking powders.

Water-Soluble Packet - WSP - Used to reduce the mixing and handling hazards of some highly toxic pesticides. Pre-weighed amounts of wettable powder or soluble powder formulations are packaged in water- soluble plastic bags. The bags dissolve and release their contents to mix with the water when dropped into a filled spray tank.

Wettable Powder - WP or W - Dry, finely ground formulations which look like dust. The a.i. is combined with a finely ground dry carrier, usually mineral clay, along with other ingredients that enhance the ability of the powder to suspend in water. The powder is mixed with water for application as a spray. This is one of the most widely used pesticide formulations.

References and Resources

Buffington, E.J. and McDonald, S.K. 2001. *General Colorado*

Commercial Pesticide Application and Safety Training Guide. Colorado State University and Colorado Department of Agriculture, Fort Collins, Colorado.

Applying Pesticides Correctly, A Guide for Private and Commercial Pesticide Applicators. Bulletin 825. Published by the Ohio State University, 1992.

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PSEP Fact Sheet:

Pesticide Residues in Perspective

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Pesticide residues are substances which remain in or on soil, air, water, or a feed or food commodity following the use of a pesticide. Pesticide residues in food and water are expressed as parts per million (ppm), parts per billion (ppb), and parts per trillion (ppt). The following comparisons may help put these quantities into perspective.

1 ppm = 1 gram (g) of residue in 1,000,000 g of food
- = 1 inch in 16 miles
- = 1 square inch in the infield of a baseball diamond
- = 1 second in 11 days
- = 1 cent in $10,000
- = 1 pancake in a stack 4 miles high
- = 1 ounce of sand in 31¼ tons of concrete
- = 1 ounce of dye in 7,530 gallons of water
- = 1 ounce of salt in 62,500 pounds of sugar

1 ppb = 1 gram (g) of residue in 1,000,000,000 g of food
- = 1 inch in 16,000 miles
- = 1 square foot in 36 square miles
- = 1 second in 32 years
- = 1 cent in $10 million

1ppt = 1 gram (g) of residue in 1,000,000,000,000 g of food
- = 1 inch in 16 million miles (33 trips to the moon and back)
- = 1 square foot of floor tile on a floor the size of the state of Indiana
- = 1 second in 32,000 years
- = 1 pinch of salt in 10,000 tons of potato chips (approximately 1,000 18-wheelers loaded with potato chips)

Toxicity is the natural capacity of a substance to produce injury. The toxicity of a pesticide is determined by laboratory testing on animals such as rats, mice, and rabbits. The measuring method, LD50 (lethal dose, 50 percent) describes the dose of a pesticide that will kill ½ of a group of test animals from a single dose. A pesticide with a lower LD50 is more toxic than a pesticide with a higher number because it takes less of the pesticide to kill half of the test animals. The LD50 corresponds with the signal word of a pesticide label and the dosage that will affect you. Always remember, "The dose determines the toxicity of the poison."

Pesticides are usually applied at an application rate of 1 pound per acre or some fraction of a pound per acre. One teaspoon of sugar spread evenly over 5,000, 5-inch cereal bowls is an application rate

of 1 pound per acre. Newer pesticides are applied at even lower rates. If the rate is 1/8 pound (2 ounces) per acre, then that teaspoon of sugar is spread over 40,000 bowls of cereal. One ounce per acre equals 1 teaspoon spread over 80,000 bowls of cereal; ½ ounce per acre equals 1 teaspoon of sugar spread over 160,000 bowls of cereal.

References and Resources

Grodner, M. 1996. A Proper Perspective on Pesticide Toxicity, Louisiana Cooperative Extension Service, Baton Rouge, Louisiana.

Buffington, E. J. and S. K. McDonald. *Pesticide Residues in Perspective*. Pesticide Fact Sheet #116. Colorado State University, Cooperative Extension. 2000

Pesticide Label Signal Word	Toxicity	LD_{50} mg/kg	
		Oral	*Dermal*
Danger-Poison	High	0-50	0-200
Warning	Moderate	50-500	200-2000
Caution	Low	>500	>2000

Sample LD_{50} Values		
	*Oral (Ingestion) mg/kg**	*Dermal (skin) mg/kg**
Synthestic Pesticides		
2, 4-D	699	800-1500
Captan	9000	-----
Diazinon	300-400	3600
Malathion	1000-2800	4100
Roundup	4300	7940
Sevin	246-283	4000
Tordon	8200	>4000
Naturally Occurring Pesticides		
Boric acid	2660-5190	-----
Caffeine	192[a]	-----
Nicotine	50-60[b]	-----
Pyrethrins	1500	>1800
Rotenone	132-1500	-----
Ryania	1200	-----
Strychnine	30-60	-----
Others		
Aspirin	750[c]	-----
Gasoline	50-100	-----
Salt	3320-4180	-----

*mg/kg of body weight

a 192 mg/kg is approximately equal to ingesting a fatal dose of 100 cups of coffee

b 50-60 mg/kg is approximatley equal to ingesting a fatal dose of two cigarettes

c 760 mg/kg is approsximately equal to ingesting a fatal dose of 15 to 45 tablets

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PSEP Fact Sheet:

Properly Rinse Pesticide Containers

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Proper rinsing of empty pesticide containers is a requirement of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Properly rinsed pesticide containers are considered non-hazardous solid waste by the federal Resource Conservation and Recovery Act (RCRA), and by the Wyoming Department of Agriculture. Properly rinsed pesticide containers save money and protect people and the environment, especially groundwater. Proper rinsing is required to recycle containers. Rinsing pesticide containers is important to accomplish the end goal of making containers a non-hazardous solid waste and ensuring that all of the pesticide, including that in the rinsate, is used on the target. Rinsate from containers should be added to the sprayer tank so it does not become a hazardous waste.

The proper rinse procedure requires that you plan ahead!

- Read and follow label directions!
- Wear the required protective clothing and equipment.
- Rinse containers immediately after emptying because pesticides will dry or solidify quickly and become difficult to remove.
- Consider the volume of the rinsate when filling the sprayer tank. Leave enough room in the sprayer tank to accommodate the rinsate before filling the tank.
- Have back-flow protection when filling a sprayer tank and rinsing the container.

You have two acceptable ways to rinse empty pesticide containers:

1. Triple-rinsing
2. Pressure-rinsing (jet-rinsing) using a device specifically manufactured to wash container interiors.

How to triple-rinse containers

Allow empty pesticide container to drain into the sprayer tank for *at least* 30 seconds. Fill container one-quarter full of clean water or appropriate spray rinse diluents. Replace cap securely and roll, swirl, and shake the contents vigorously for at least *one full minute* to rinse all surfaces! Remove container cap and empty rinsate into the spray tank. Allow the container to drain for *at least* 30 seconds. Repeat the fill, shake, and drain procedure two more times using clean water. Properly dispose of the rinsed containers as soon as possible. Dispose of caps with the containers unless recycling. Plastic and plastic-lined bags can be triple-rinsed. For paper and fiber bags and similar containers, completely empty the contents into the tank. Open both ends of the container to remove any remaining pesticide and to prevent reuse. Add rinsate to target site as specified in the label.

How to pressure-rinse containers

Allow the empty pesticide container to drain into the sprayer tank for *at least* 30 seconds. Hold the container upside down over the sprayer tank opening so that rinsate will run into the sprayer tank. For ease and safety, puncture through the bottom of metal containers and through the side of plastic containers with appropriate tool or pressure-rinsing nozzle. F*ollow specific manufacturer directions*. Thoroughly rinse the empty container for the time interval recommended by the pressure-rinse nozzle manufacturer but *no less* than 30 seconds, using at least 40 pounds per square inch water pressure. Properly dispose of the rinsed containers as soon as possible. Remove and discard caps before recycling. Add rinsate to target site as specified in the label.

Some manufacturers and suppliers of pressure-rinsing equipment:

GEMPLER'S
P.O. Box 270
100 Countryside Drive
Belleville, WI 53508
voice: 1-800-382-8473
fax: 1-800-551-1128
http://www.gemplers.com

JetRinse
Select Styled Systems, Ltd 100 E. School Rd Palmer, IA 50571
712-359-2467
sales@jetrinse.com http://www.jetrinse.com/

Qwik-Rinse, Inc.
P.O. Box 3453
Richmond, VA 23235
voice: 804-272-7065
toll free voice: 1-800-645-7291 http://security-one.com/qwik-rinse/ kermfaye@erols.com

Many pesticide, farm, and nursery equipment dealers also sell pesticide rinse nozzles.

Recycle your plastic pesticide containers! Contact your local weed and pest district to see if there is a recycling program in your area.

Remember:

- Always read and follow label directions!
- Wear proper protective clothing and equipment.
- Dispose of rinsed containers promptly and properly.
- Recycle plastic pesticide containers whenever possible! They must be empty, properly rinsed, dry, and with caps removed. Caps do not recycle.
- Add rinsate to target site as specified in the label.

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PSEP Fact Sheet:

Tank Mixing

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Pesticide handlers often like to combine two or more pesticides and apply them at the same time. Such mixtures, often called **tank mixes**, can save time, labor, and fuel. Manufacturers sometimes combine pesticides for sale as a premix.

Under federal law, combining pesticides is legal unless the pesticide labeling of any of the pesticides involved instructs you not to combine them. However, not all pesticides work well when mixed together. They must be **compatible** – that is, mixing them together must not reduce their safety or effectiveness. The more pesticides tank-mixed, the greater the chance of undesirable effects.

Some pesticide mixtures that are physically incompatible make the mixture difficult or impossible to apply and may clog equipment, pumps, and tanks. These reactions sometimes cause the pesticide to form lumps or gels, to become solids that fall to the bottom of the mix tank, or to separate into layers that cannot be remixed.

Sometimes the combined pesticides create a chemical reaction that cannot be seen by looking at the mixture. However, the chemical change can result in:

- loss of effectiveness against the target pests,
- increased toxicity to the pesticide handler, and
- injury to the treated surface.

Some pesticide labeling lists pesticides (and other chemicals) known to be compatible with that formulation. Compatibility charts are available in some pest management recommendations, pesticide trade publications, and extension or industry recommendations. If a chart cannot be found that lists the compatibility of the two pesticides (or the pesticide and other chemical) that are to be mixed, test a small amount of the mixture before large quantities are mixed.

Compatibility testing

First, put on personal protective equipment (PPE). Wear at least the equipment required by the labeling of any of the pesticides to be combined including protective eyewear and chemical-resistant gloves and apron, both preferably made of foil laminate. Get a large, clean, clear glass container, such as a quart jar. Use the same water (or other diluents) that will be used when making up the larger mixture. Add the water and each of the products in the same proportions as they will be mixed. Unless the pesticide labeling states otherwise, add pesticides to the diluents (usually water) using the "W-A-L-E" plan (add Wettable powders first, then Agitate, add Liquids, add Emulsifiable concentrates last).

Shake the jar vigorously. Feel the sides of the jar to determine if the mixture is giving off heat. If so, the mixture may be undergoing a chemical reaction, and the pesticides should not be com-

bined. Let the mixture stand for about 15 minutes, and feel again for unusual heat.

If scum forms on the surface, if the mixture clumps, or if any solids settle to the bottom (except for wettable powders), the mixture probably is not compatible. Finally, if no signs of incompatibility appear, test the mixture on a small area of the surface where it is to be applied.

When preparing a tank mix, it is wise to take a few moments to prepare a record of the following items:

- The order in which to mix the products
- Prescribed rates per acre or square feet for each product
- Capacity of the spray tank
- Amount of mix to be applied per acre
- Types and rates of any additives
- Acres covered per tank
- Types of nozzle(s) to be used
- Nozzle pressure in pounds per square inch (psi)
- Applicator speed

This information, along with the application location, target area, and date of product application, will help provide you with an important record and a handy reference.

References and Resources

Applying Pesticides Correctly. National Pesticide Applicator Training Core Manual. United States Department of Agriculture and Environmental Protection Agency.

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2 Safety

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PSEP Fact Sheet

First Aid for Pesticide Poisoning

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Many accidental pesticide deaths are caused by eating or drinking the chemical. Some applicators die or are injured when they breathe pesticide vapors or get pesticides on their skin. Repeated exposure to small amounts of some pesticides can cause sudden, severe illness. All pesticide handlers should know and understand first aid treatment for pesticide poisoning. Specific instructions pertaining to first aide related to the exposure to any product can be found on the product label.

First Aid for Pesticide Poisoning

If you are alone with the victim:

- See that the victim is breathing; if not, give artificial respiration. To avoid self- contamination, wipe the victim's mouth **before** giving artificial respiration.
- Decontaminate the victim by flushing the mouth with water immediately. Speed is essential!
- Call your doctor.
- Call the Poison Control Center, 1-800-955-9119 (all areas, toll-free).
- Know your hospital and doctor's phone numbers

Do not substitute first-aid for professional treatment!

If two or more people are with the victim, speed is essential! One person should begin first-aid treatment while the other calls a physician.

General

- If breathing has stopped or is labored, artificial respiration must be given, preferably by someone certified in cardio-pulmonary resuscitation (CPR).
- Stop exposure to the poison. If the poison is on the skin, cleanse the person thoroughly.
- Save the pesticide container; get a readable label or name of the chemical or chemicals.

Specific Poison on Skin

- Drench skin and clothing with water (shower, hose, and faucet). A powder formulation can be brushed off, followed by washing.
- Remove shoes first, and then remove other clothing. Shoes will trap chemicals and be absorbed into the skin.
- Cleanse skin and hair thoroughly with soap and water.

Poison in Eyes

- Hold eyelid(s) open, wash eyes immediately with gentle stream of clean, running water. Tilt head so poison does not run from one eye into the other.
- Continue washing intermittently for 15 minutes or more.
- DO NOT use chemicals or drugs in wash water.

Inhaled Poisons (dusts, vapors, gases)

- If the victim is in enclosed space, do **not** go in after him or her without air-supplied respirator.
- Carry the patient to fresh air.
- Loosen all tight clothing.
- Apply artificial respiration if the victim is not breathing or if breathing is extremely shallow. Assist respiration by giving a breath once every five seconds. The pulse should also be monitored. If there is no pulse, cardiopulmonary resuscitation must be given. The chances of success are greatly increased and the likelihood of injuring the victim are greatly decreased if CPR is administered by someone qualified.
- Call a physician.
- Prevent chilling.
- If the patient is convulsing, watch his or her breathing. Keep the chin up so the air passage remains free. If convulsing, put the victim on his or her side and maintain the head-tilt to keep the airway open.
- Do not give alcohol in any form.

Swallowed Poisons

- Call the Poison Control Center immediately: 1-800-222-1222.
- DO NOT induce vomiting if the patient is in a coma or unconscious or has swallowed petroleum products or a corrosive poison (strong acid or alkaline products).
- If the patient can swallow after ingesting a corrosive poison, administer one of the following: for acids - milk, water, or milk of magnesia diluted 1 tablespoon to 1 cup of water; for alkali - milk or water, giving 1 to 2 cups to patients 1 to 5 years old and up to 1 quart to patients 5 years and older.

Chemical Burns of Skin

- Wash with large quantities of running water.
- Remove shoes and then the contaminated clothing. Brush away dry chemical and wash.
- Wash the victim with large quantities of water. Immediately cover with a loosely applied, clean cloth.
- Avoid use of ointments, greases, or powders.
- Treat shock by keeping the patient warm and elevating his or her feet 10 to 12 inches.

This information should be posted in an area where pesticides are stored or mixed, prefer- ably in a laminated or plastic cover.

Material adapted from: Roy Linn, farm safety and agricultural energy specialist, Cooperative Extension Service, Montana State University. *First Aid for Pesticide Poisoning MONTGUIDE A-6 MT8420.*

Risk = Toxicity x Exposure

Risk can be lowered by understanding the toxicity of a product and the potential for personal exposure. The dermal absorption chart indicates how dermal absorption varies, depending upon which part of the body is exposed. No matter how toxic a pesticide is, if the amount of exposure is kept low, risk can be held at an acceptably low level. Use of appropriate protective clothing and equipment (PPE) will help reduce your risk by preventing or reducing exposure (see Protective Clothing and Equipment for Pesticide Applicators, NebGuide G758, Pesticide Safety: choosing the Right Gloves, NebGuide G1961 located online at http://www.ianrpubs.unl.edu).

Knowing the proper procedures when handling pesticide contaminated clothing will also reduce potential exposure to pesticides; refer to Washing Pesticide Contaminated Clothing Card, EC509 (located online at http://www.ianrpubs.unl.edu).

If at any point you transport a pesticide exposure victim to a health care facility be certain to 1) Call ahead and inform the health care workers the exposure type and the material to which they were exposed. 2) bring along the product Label and Safety Data Sheet.

Pesticide Poisoning Symptoms *are often similar to influenza*	
Mild	Fatigue, headache, dissiness, blurred vision, excessive sweating, nausea, vomiting, stomch cramps, and diarrhea.
Moderate	Unable to walk, weakness, chest discomfort, muscle twitches, pupil constrictino
Severe	Unconsciousness, severe pupil constriction, muscle twitches, body secretetions, breathing difficulty

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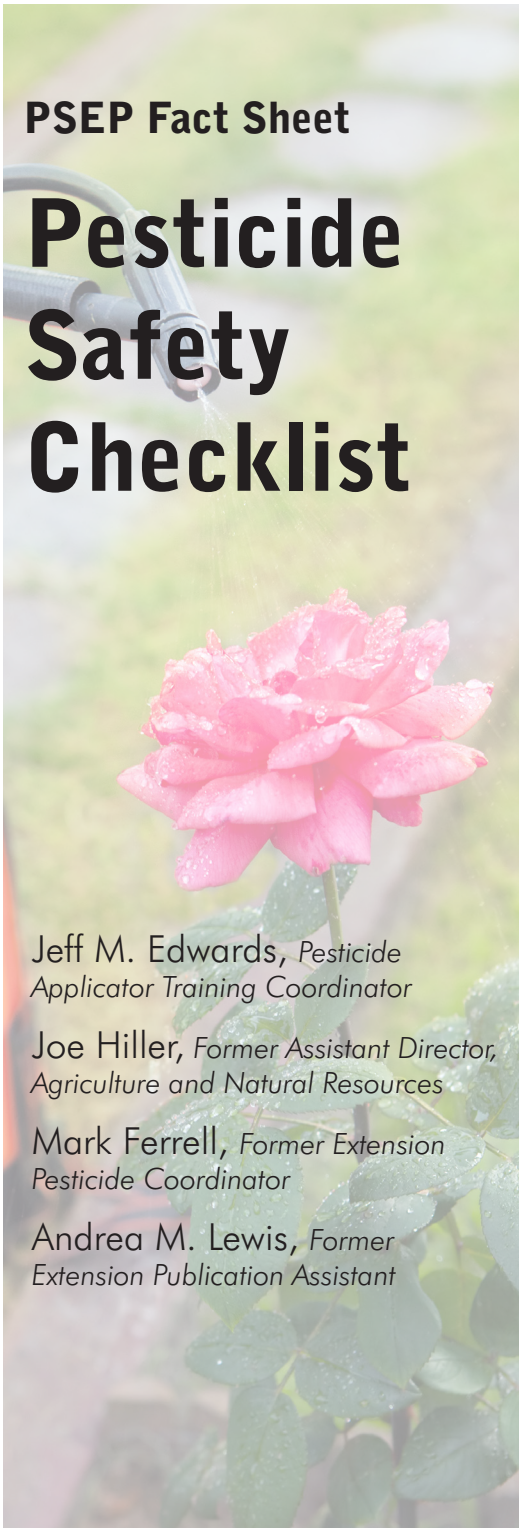
PSEP Fact Sheet

Pesticide Safety Checklist



Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Overlooking important safety precautions when using pesticides is sometimes easy. The following checklist is a reminder that applicators should never be too busy to overlook safety.

- Read the label carefully and take notice of personal safety and environmental precautions. The label information is not advertising - it is solid science. Labels include the proper rate of pesticide use for various conditions, the relative toxicity of the product, directions for safe mixing and application, and any environmental precautions. They list the product manufacturer's name and address, required protective clothing, and warnings about groundwater contamination and hazards to wildlife.
- Wear appropriate personal safety equipment (PPE) when handling pesticides. Start by wearing a wide-brimmed hat, long-sleeve shirt, long pants, rubber boots, and chemical-resistant gloves. Depending on the product being used, applicators may be required to wear goggles, a face shield, or a respirator. Read the product label to determine what PPE is required.
- When mixing or loading chemicals, prevent spills that might contaminate water supplies. Prevent tank overflow by never leaving a sprayer unattended during filling. Mixing and loading operations should always take place as far away from a wellhead or other water sources as possible to reduce the risk of contamination.
- While filling sprayers, avoid backsiphoning by keeping the discharge end of the fill hose above the tank's water level. If the end of a hose is put down into the pesticide liquid in the tank, there is a risk that the hose will suck water and chemicals back into the water source when the water is turned off.
- Never exceed label rates. Read the label to determine the application rate for both the target site and the target pest.
- Calibrate the sprayer before application. It is important to make sure the sprayer is delivering the right amount of product per acre or square foot. Calibration makes more than economic sense; it also helps protect the environment.
- Prevent leftover pesticide by mixing only as much as is needed. If label instructions for application rates are followed and mixed carefully, the tank should be empty at the end of each application.
- Never rinse equipment near wellheads, ditches, streams, or other water sources. If needed, install a longer rinse water hose to move the cleaning operations a safe distance from a well or other water source. Spray the rinse water in the spray tank out over the target site following label instructions.

- Always triple rinse or jet rinse chemical containers before disposal or recycling. A pesticide container can be disposed of properly once it has been properly rinsed. Puncture empty plastic containers to prevent reuse, and recap plastic and glass containers.

References and Resources

Pesticide Safety Checklist. Alliance for a Clean Rural Environment (ACRE), Kansas City, Missouri.

Pesticide Safety Checklist. E.J. Buffington and S.K. McDonald. Pesticide Fact Sheet #128. Colorado State University, Cooperative Extension. 2001

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PSEP Fact Sheet

Choosing Chemical-Restistant Pesticide Application Equipment

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Many pesticide labels instruct the user to wear personal protective equipment (PPE) clothing and devices that protect the body from contact with pesticides or pesticide residues. Some labels require the use of chemical-resistant PPE items that the pesticide cannot pass through during the time it takes to complete the task. The labels of a few pesticides, such as some fumigants, prohibit the use of chemical-resistant PPE.

Most chemical-resistant PPE items are plastic or rubber. But not all these materials are equally resistant to all pesticides under all conditions.

Chemical Resistance

Three factors affect a material's chemical resistance: the exposure time, the exposure situation, and the chemical properties of the pesticide product to which the material is exposed.

Exposure time

Not all types of materials that are resistant to a particular pesticide will provide protection for the same amount of time. Some will keep the pesticide out for a long time. Others will allow the pesticide to reach the skin fairly quickly. Disposable plastic gloves, shoe covers, or aprons may provide enough protection for tasks that can be done in a few minutes. Longer jobs usually require items made of a more-resistant material.

A pesticide begins to move into a material as soon as it gets on the surface. The pesticide continues to move into and through the material until the pesticide is removed. Help prevent pesticides from getting through chemical-resistant items, such as gloves, boots, and aprons, by regularly rinsing off pesticides that are splashed or spilled on protective equipment.

Chemical resistance is often stated in terms of exposure time. For example, neoprene may be resistant to one solvent for 30 minutes or less and to another solvent for more than four hours.

Exposure situation

A chemical-resistant material will not continue to be protective if it is damaged. For tasks that involve handling sharp objects or walking through rough terrain, a sturdy material is necessary to resist punctures or tears.

Type of chemical

No single material can protect against all pesticide products. The chemical resistance of a material depends on whether the pesticide is liquid or dry and what diluents or solvents are used.

Choosing Chemical-Resistant Materials

The pesticide label may state what materials are chemical-resistant to the pesticide product; if not, look for another source of help in making a selection. The Environmental Protection Agency, the United States Department of Agriculture Cooperative Extension Service, pesticide producers, or PPE dealers may offer guidance.

Unless the pesticide label directs otherwise, do not use items that are made of or lined with absorbent materials such as cotton, leather, and canvas. These materials are not chemical resistant, and they are difficult or impossible to clean after a pesticide gets on them. Even dry formulations can move quickly through woven materials and may remain in the fibers after several launderings.

Gloves and footwear made of polyvinyl chloride (PVC) or rubber (butyl, nitrile, neoprene, or natural rubber) must be at least 14 mils thick.

Pesticides can leak through stitching holes and gaps in seams. For chemical resistance, choose PPE with sealed seams.

Barrier-laminate materials are resistant to most pesticides and are a good choice for many situations.

Barrier-laminate (Silver Shield/4-H) gloves may be uncomfortable and clumsy to wear for some kinds of tasks. Try wearing fitted rubber gloves over barrier-laminate gloves for comfort, protection, and dexterity.

Any plastic or rubber material is resistant to dry pesticides and to water-based pesticides (those that use water as the only diluents or solvent).

Dry pesticides include dusts, granules, pellets, and some baits. Water-based pesticides include wettable powders, soluble powders, some solutions, dry flowables (water-dispersible granules), and microencapsulated pesticides.

Chemical resistance to non-water-based liquid pesticides depends on the type of solvent in the formulation.

Liquid pesticides that are not water-based may be emulsifiable concentrates, ultra-low-volume and low-volume concentrates, low-concentrate solutions, flowables, aerosols, and invert emulsions. Common solvents are xylene, fuel oil, petroleum distillates, and alcohol. If the label does not indicate the types of materials that are chemical-resistant to the pesticide product, select sturdy barrier-laminate, butyl, or nitrile materials. Then watch for signs that the material is not chemical-resistant.

Sometimes it is easy to see when a plastic or rubber is not resistant to a pesticide. The material may:

- change color
- become soft or spongy
- swell or bubble
- dissolve or become jelly-like
- crack or get holes
- become stiff or brittle

If any of these changes occur, discard the item through proper disposal (call your local UW Extension office for information on proper disposal) and choose another type of material.

This bulletin was adapted from a publication produced by the Environmental Protection Agency and the Extension Service, U.S. Department of Agriculture. *Personal Protective Equipment Guide, Choosing Chemical Resistant PPE.*

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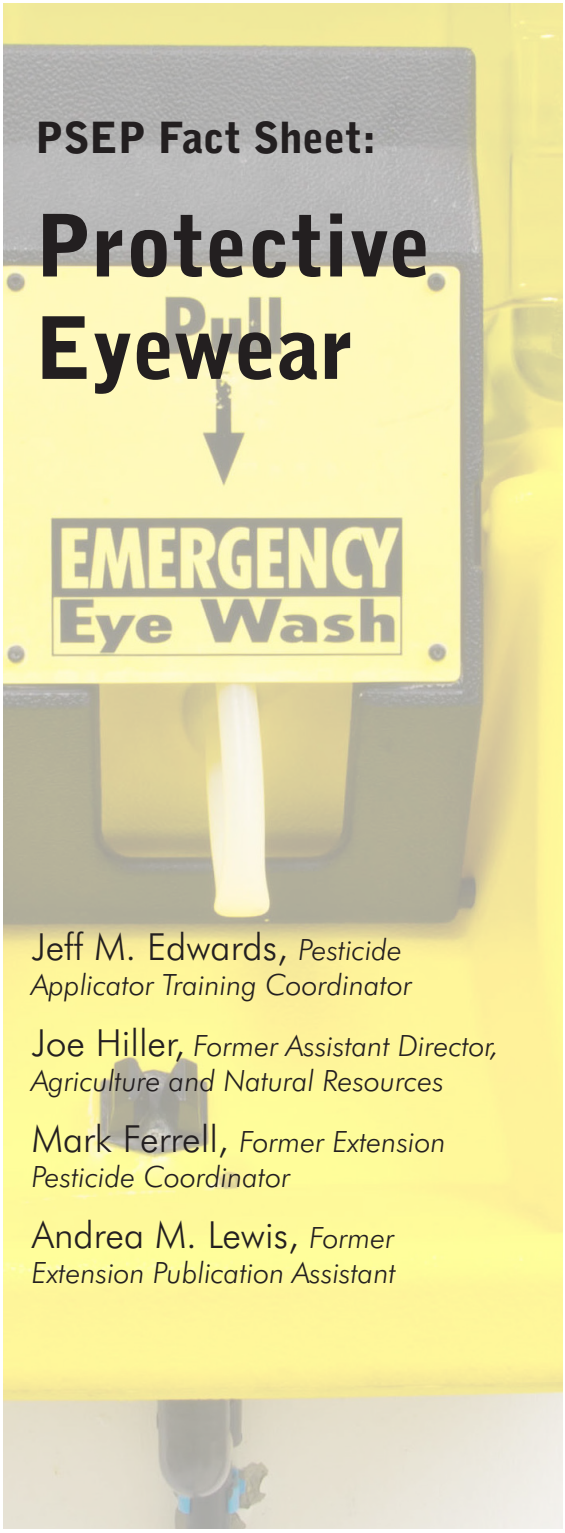
PSEP Fact Sheet:

Protective Eyewear



Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

When the label requires protective eyewear, wear goggles, a face shield, or shielded safety glasses. Consider wearing protective eyewear in any situation where pesticides may get into the eyes, even if the pesticide label does not require eye protection. Eyes are very sensitive to the chemicals in pesticide formulations and readily absorb some pesticides.

Shielded safety glasses

Shielded safety glasses are often a good choice because they are comfortable, do not cause fogging or sweating, and give good eye protection in many situations. Safety glasses must have brow and side shields.

Face shields

Face shields have many of the advantages of shielded safety glasses and provide additional protection to the entire face. Face shields that are cupped inward toward the throat give better protection from splashes than straight face shields.

Goggles

When riding in an open cab during an air blast application, flagging under an aerial application, applying mists, fogs, or aerosols indoors, or working in similar situations, consider choosing goggles that fit tightly against the face. These provide more protection in such situations than shielded safety glasses or face shields. A full-face respirator also would protect the eyes in these conditions.

Protective eyewear with respirators

Either goggles or shielded safety glasses can be worn with a half-face respirator. Choose styles that fit comfortably with the respirator. Full-face respirators cover the eyes; no additional eye protection is required.

Face shields over goggles

In high exposure situations when both face protection and eye protection are needed, a face shield can be worn over goggles.

Eyeflush Dispensers

Whenever the pesticide label requires protective eyewear, also have an eyeflush dispenser handy. It is important to act quickly if a pesticide gets into the eyes because they can be severely damaged in just a few minutes.

Styles

Eyeflush equipment may be either portable eyeflush dispensers or permanently installed eyeflush stations. Portable eyeflush dispensers should contain at least one pint of water-either potable water or a special fluid made for eyeflush dispensers. Permanently mounted eyeflush stations should be connected to a supply of potable running water or contain a reservoir of at least one pint of potable water or eyeflush fluid.

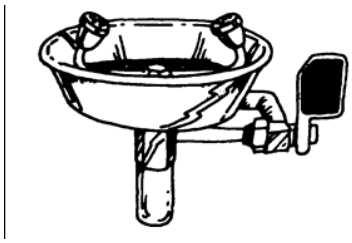
Using an eyeflush dispenser

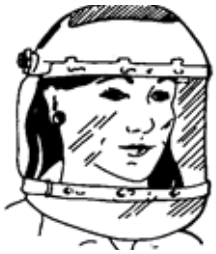
Both styles of dispensers allow a gentle trickle of water to flow across the open eye. Wash the eye for about 15 minutes to be sure that all the pesticide is removed.

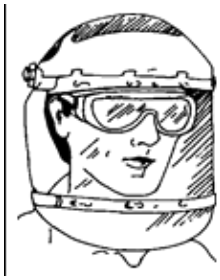
This bulletin was adapted from a publication produced by the Environmental Protection Agency and the Extension Service, U.S. Department of Agriculture. *Personal Protective Equipment Guide, Protective Eyewear.*

Interpreting PPE Statements on Pesticide Labels

Label Statement	Acceptable PPE
Protective eyewear	Shielded safety glasses, face shield, goggles, or full-face repirator
Goggles	Goggles or full-face respirator







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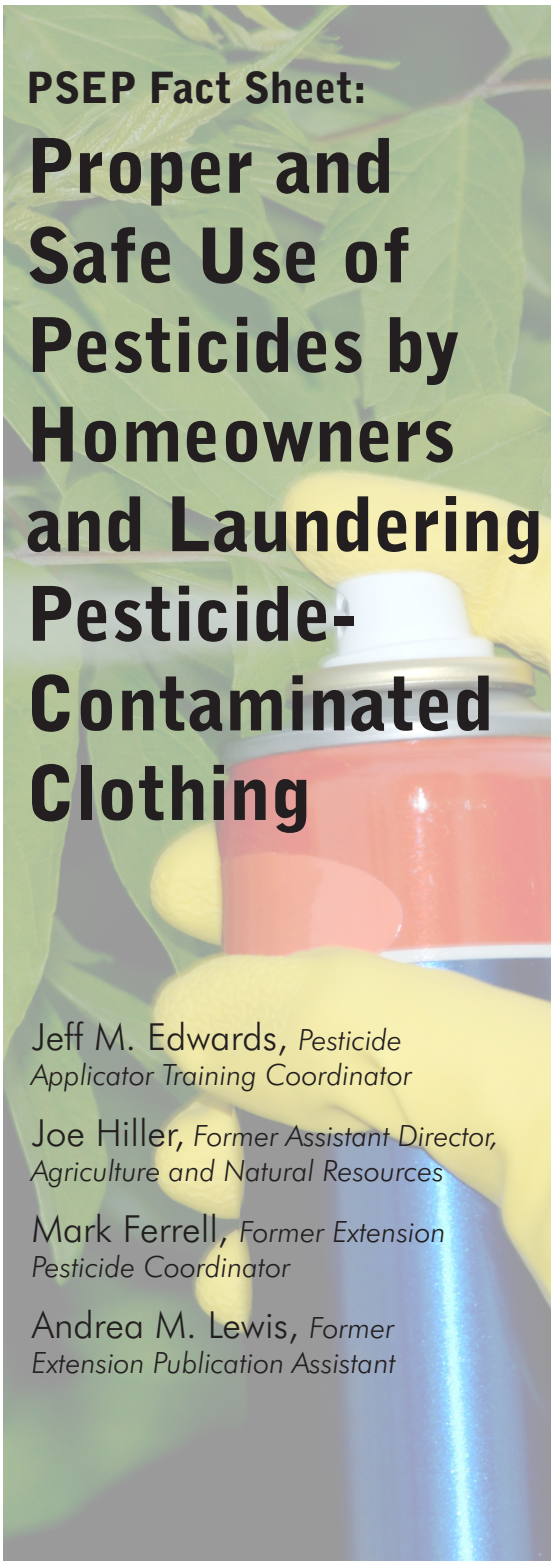

PSEP Fact Sheet:

Proper and Safe Use of Pesticides by Homeowners and Laundering Pesticide-Contaminated Clothing

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Select the proper pesticide, if needed

- Identify the pest you wish to control. If you can't do it yourself, seek help from a professional, such as your county extension educator.
- Pesticides are one of many tools available for controlling pests. If you use a pesticide, check your information sources thoroughly before selecting the most appropriate chemical.
- The most important step in selecting any pesticide is to **read the entire label and the MSDS**! Read and understand the product label thoroughly before you purchase, mix, apply, store, or dispose of a pesticide.
- Buy only the amount of pesticide you need!

Prepare for safe pesticide use

Make sure the label of the pesticide you choose contains the following information that is specific to your pest problem:

- **the site** you need to use the pesticide in or on
- **the pest** you want to control
- **the equipment** you need to apply it with

Before opening a pesticide container, read the entire label - understand signal words and safety precautions, and know what to do in case of an accidental poisoning or pesticide emergency. If you don't understand the instructions, contact your county extension educator for help.

The label is the law – You are liable to read, understand, and follow all instructions on the label.

Make sure you have on hand or can get the kinds of application and personal protective equipment and clothing specified on the label. Put all personal protective equipment on before you open the pesticide container and begin to mix and apply the pesticide!

Open, mix, and dilute the pesticide outdoors or in a well-ventilated area.

Apply pesticides safely

Follow all use directions carefully! Use only the amount directed, at the time and under the conditions specified, and for the purpose(s) listed.

You may not purchase or use restricted use pesticides unless you are a certified applicator licensed by the Wyoming Department of Agriculture.

Always keep children and pets away from the areas where you mix or apply pesticides!

Never apply pesticides outdoors on windy or rainy days.

Never eat, drink, or smoke while using pesticides.

Remove all objects that might be damaged or contaminated by pesticides from the areas to be treated. Don't replace them or use the area until the waiting time specified on the label has elapsed.

When treating fruits and vegetables in gardens, observe the time-to-harvest, also known as the pre-harvest interval [PHI] waiting period on the label. This period varies with the pesticide used and the food plant treated.

Properly store and dispose of pesticides

Store pesticides and other dangerous household chemicals securely so children, pets, and others who might not understand the label will not be able to reach them. Do not store pesticides near wells or other sources of water!

Never put pesticides into food or drink containers. Never place pesticides in any container other than the original container or the application equipment.

Dispose of waste pesticides and pesticide containers according to the label and local and state laws. Never pour chemicals down the drain! Call or write your extension office for information on proper disposal.

Clean up!

If you spill a pesticide, clean it up immediately and according to the label directions. Clean it up; don't merely try to wash it away! Properly dispose of clean-up materials!

Shower and shampoo thoroughly after using pesticides.

Wash your contaminated clothing separately from the family laundry.

If you do not understand the label instructions, call or write your local extension office or weed and pest office for help.

Read and follow label directions!

Material adapted from: P.M. Horton, pesticide coordinator, Cooperative Extension Service, Clemson University. *How to Use Homeowner Pesticides Safely, Pesticide Information Program Information Sheet PIP-IS-20-89.*

Laundering Pesticide-Contaminated Clothing

Consider using disposable clothing (ie., Tyvek) thus reducing exposure via laundering. Read pesticide labels to check for any special instructions. Pesticide formulation has the greatest influence on how easily clothing will launder clean. The best option for reducing exposure to yourself and your family is choosing disposable PPE.

Applicators should start with new or very clean coveralls each application season. Do not wear contaminated clothing. Launder clothing after each use. For best results, clothing should be washed soon after being exposed to pesticides. The longer clothing is stored before washing, the more difficult it is to remove pesticides from it.

Empty pesticide granules from cuffs and pockets. Do this outdoors. If granules are left in the clothes, they will dissolve in the wash water and may not be completely removed from the clothing during the wash cycle.

If concentrated liquids are spilled on clothing, **discard the clothing**.

High levels of an undiluted emulsifiable concentrate can remain in clothing even after 10 washes.

Contaminated clothing should be stored and washed separately from other family clothing because residues can be transferred from contaminated clothing to other items. Those washing laundry should know which clothing has been worn to apply pesticides and should wear rubber gloves when handling highly contaminated clothing to prevent absorbing pesticide into the body through the hands.

Pre-rinse or pre-soak contaminated clothing and thoroughly wring or spin the water out before washing. Pre-rinsing is especially useful for removing wettable powder formulations.

Use the longest wash cycle with hot water and a full-rinse cycle. Hot water is more effective in removing pesticides than warm water. Cold water is much less effective. Hot water is defined as 140º F, warm as 120º F, and cold as 86º F or lower. Do not overload the washing machine. Use the appropriate water level.

Use the recommended amount of detergent. Most people do not use enough detergent. In hard water areas or when clothing is especially dirty, use more detergent. Liquid detergents are more effective than powdered detergents for removing oil-based pesticides. Neither bleach nor ammonia has been shown to contribute to pesticide removal.

Line drying in direct sunlight is recommended.

Run the washing machine through a cycle without any clothes to remove pesticide residues before washing other clothing.

When in doubt of condition of clothing, discard them.

Precautionary Statement

All pesticides have both benefits and risks. Benefits can be maximized and risks minimized by reading and following labeling. Pay close attention to directions for use and precautionary statements. The information on pesticide labels contains both instructions and limitations. Pesticide labels are legal documents, and it is a violation of both federal and state laws to use a pesticide inconsistently with its labeling. A pesticide applicator is legally responsible for the proper use of pesticides. Always read and follow labels.

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PSEP Fact Sheet:

Inspecting, Maintaining, and Replacing Pesticide Application Equipment and Personal Protective Equipment

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Clothing and devices that protect the body from pesticides are called personal protective equipment (PPE). All PPE either should be disposable or easy to clean and sturdy enough for repeated use. To remain protective, PPE must be maintained carefully and replaced as necessary.

Disposables

Disposable PPE items are not designed to be cleaned and reused. Discard them when they become contaminated with pesticides.

Chemical-resistant gloves, footwear, and aprons labeled as disposable are designed to be worn for a limited time and then thrown away. These items often are made of thin vinyl, latex, or polyethylene. Inexpensive disposables may be a good choice for brief tasks requiring flexibility and when doing tasks that will not tear the thin material.

Non-woven (including coated non-woven) coveralls and hoods usually are designed to be disposed of after use. Most are intended to be worn for only one workday's exposure period. The instructions for some coated non-woven suits and hoods may permit them to be worn more than once if each period of use is short, and they do not get much pesticide on them. Be alert when reusing non-woven items, and change them if pesticides are getting through or if the inside surface is contaminated.

Prefilters, canisters, cartridges, and some respirators are disposables. They cannot be cleaned and reused.

Reusables

Some PPE is designed to be cleaned and reused. However, do not reuse items that can no longer provide protection.

Rubber and plastic suits, gloves, boots, aprons, and headgear often are designed to be cleaned and reused, but even these should be replaced often. Wash them thoroughly between uses. Before putting them on, inspect reused items carefully for signs of wear or abrasion. If they show any sign of wear, throw them away. Even tiny holes or thin places can allow large amounts of pesticide to move to the inside surface and get on the skin. Check for rips and leaks during cleaning by using the rinse water to form a "balloon" or by holding the items up to the light.

Even if there are no signs of wear, replace reusable chemical-resistant items regularly. Residues that cannot be detected may remain in the material even after washing and adequate airing and may build to a harmful level.

Follow manufacturer's instructions, if any, for replacement. A good rule of thumb is to dispose of gloves that have been worn for about one week of work. Extra heavy-duty gloves, such as those made of butyl or nitrile rubber, may last as long as two weeks. Because hand protection is the most important concern for pesticide handlers, glove replacement is a high priority. Footwear, aprons, headgear, and protective suits may last longer than gloves because they generally receive less exposure to the pesticide and less abrasion from rough surfaces. However, they should be replaced regularly and at any sign of wear.

Fabric coveralls are designed to be cleaned after each day's use and reused. However, absorbent materials such as cotton, polyester, cotton blends, denim, and canvas cannot be cleaned adequately after they are drenched or thoroughly contaminated with a concentrated pesticide labeled with the signal word **Danger** or **Warning**. Always discard any such clothing or footwear as they cannot be safely reused.

Most protective eyewear and respirator face pieces are designed to be cleaned and re-used. These items may last many years if they are good quality and are maintained correctly.

Maintaining PPE

At the end of an activity involving exposure to pesticides, remove PPE right away. Wash the outside of the gloves with detergent and water before removing them. Consider washing the outside of other chemical-resistant items before removing them also. This helps avoid contact with the contaminated part of the items and helps keep the inside surface uncontaminated. If any other clothes have pesticide on them, change them. Determine whether the items should be disposed of or cleaned for reuse.

Place reusable items in a labeled plastic bag or hamper away from other personal clothes and away from family laundry. Place disposables in a separate plastic bag or container. The pesticide remaining on PPE, work clothing, and other work items could injure people or pets that touch them. Do not allow contaminated PPE to be washed in streams, ponds, or other bodies of water. The pesticide could poison aquatic life or harm people, livestock, and wildlife.

Clean reusable PPE items between uses. Even if they were worn for only a brief period of exposure, wash them before wearing them again. Pesticide residues that remain on the PPE are likely to continue to move slowly through the PPE material, even chemical-resistant material. If the PPE is worn again, pesticide may already be on the inside. Also, PPE worn several times without laundering may build up pesticide residues. Even when the pesticides are not highly toxic, the residues can reach a harmful level.

Maintaining Eyewear and Respirators

Hand-wash goggles, face shields, shielded safety glasses, and reusable respirator face pieces after each use. Follow manufacturer's instructions, if available, or use mild detergent and warm water to wash them thoroughly. Rinse thoroughly and wipe dry or hang in a clean area to air dry.

Store respirators and eyewear where they are protected from dust, sunlight, extreme temperatures, excessive moisture, pesticides, and other chemicals. A sturdy zip-lock plastic bag works well for storage.

Respirator maintenance is especially important. Inspect respirators before each use and repair or replace them if any part shows signs of wear or deterioration. Keep an inventory of replacement parts. Use only those supplied by the original manufacturer and listed on the NIOSH approval label. Respirators kept for standby or emergency use should be inspected at least monthly and before use.

If it is necessary to remove the respirator between tasks:

- Handle it only with clean hands.
- Wipe the face piece with a clean cloth.
- Replace caps, if available, over cartridges, canisters, and pre-filters.

Seal the entire respirator in a sturdy, air-tight container, such as a zip-lock plastic bag. If the respirator is not sealed immediately after each use, the disposable

parts must be replaced more often. Cartridges, canisters, pre-filters, and filters collect impurities as long as they are exposed to the air.

At the end of any work day when a reusable respirator face piece was worn:

- Remove and discard any pre-filters.
- If removable, take off the cartridges or canisters. If they are still usable, replace the caps and seal in an airtight container, such as a zip-lock plastic bag. Discard them if they cannot be reused.
- Clean and store the respirator as directed above.

Washing PPE

Do not allow used PPE to be washed with the regular family laundry. It could cause the other items to be dangerously contaminated.

Alert the person who does the washing

Be sure the people who clean and maintain PPE and other work clothes know they can be harmed by touching contaminated items. Tell them that they should:

- Wash their hands after touching contaminated items
- Work in a well-ventilated area, if possible
- Avoid inhaling steam from the washer or dryer

Washing procedure

Follow the manufacturer's instructions for cleaning chemical-resistant items. If the instructions say only to wash the item, or if there are no cleaning instructions, follow the procedure described here. Some chemical-resistant items that are not flat, such as gloves, footwear, and coveralls, must be washed twice - once to clean the outside and a second time after turning the item inside out.

Some chemical-resistant items, such as heavy-duty boots and rigid hats or helmets, can be washed by hand using hot water and heavy-duty liquid detergent. Dry and air them as directed below.

This is the best procedure for washing non-chemical-resistant items such as cotton, cotton/ polyester, denim, canvas, and other absorbent materials, as well as most chemical-resistant items:

- Rinse in a washing machine or by hand.
- Wash only a few items at a time to allow plenty of agitation and water for dilution. Use the highest water level setting.
- Wash in a washing machine, using a heavy-duty detergent and hot water for the wash cycle.
- Rinse twice, using two rinse cycles and warm water.
- Use two entire machine cycles to wash items that are moderately to heavily contaminated.
- Run the washer through at least one additional entire cycle without clothing, using detergent and hot water, to clean the machine. Do this after washing each batch of pesticide-contaminated items and before any other laundry is washed.

Drying procedure

Hang the items to dry, if possible. Letting them hang for at least 24 hours in an area with plenty of fresh air - preferably outdoors - is a good idea. This will permit remaining pesticide residues to move to the surface and evaporate. It is good to have at least two sets of equipment so one set can air in a clean place while the other is in use. Do not hang items in enclosed living areas because pesticides that remain in the clothing may evaporate and expose people or animals.

If it is not possible to hang them to dry, using a clothes dryer is acceptable for fabric items. Over a period of time, however, the dryer may become contaminated with pesticide residues.

This bulletin was adapted from a publication produced by the Environmental Protection Agency and the Extension Service, U.S. Department of Agriculture. *Personal Protective Equipment Guide, Inspecting, Maintaining, and Replacing PPE.*

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3 Equipment & Calibration

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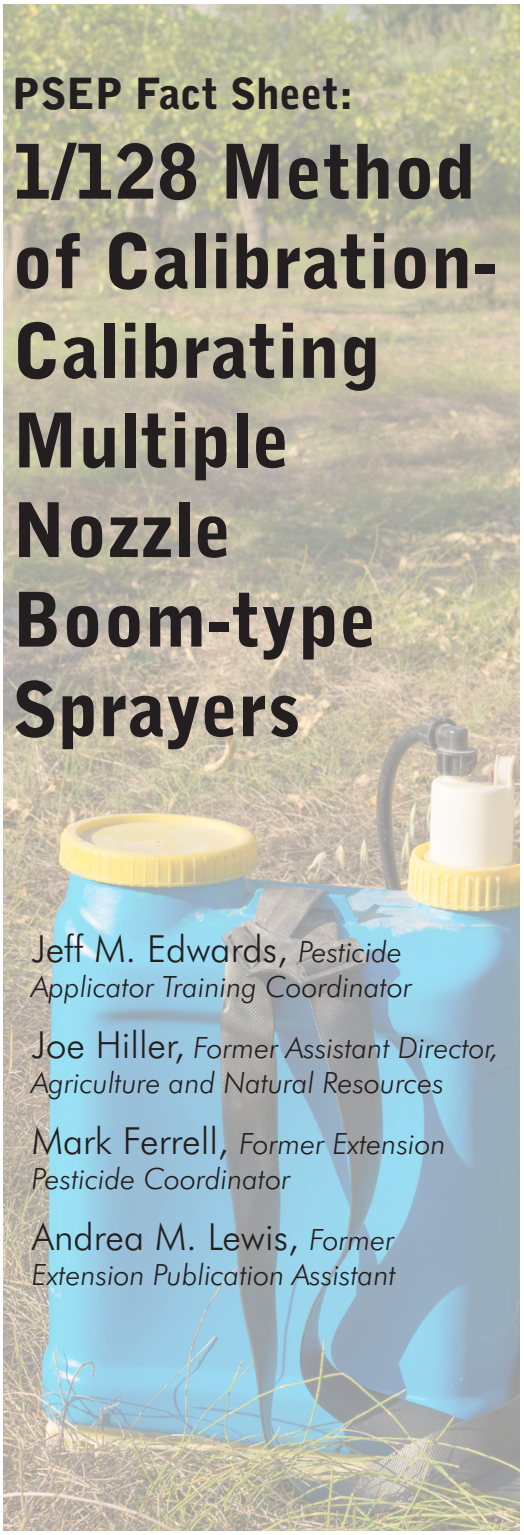

PSEP Fact Sheet:

1/128 Method of Calibration-Calibrating Multiple Nozzle Boom-type Sprayers

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Sprayer calibration using the 1/128th method is relatively easy and can be completed very quickly. The 1/128th method is also called the "ounce calibration" method. There is a direct ratio established when determining how much material is applied to 128th of an acre (128 equals the number of ounces in a gallon).

Because a gallon is 128 ounces and the test area to be sprayed is 1/128 of an acre, the number of ounces collected is equal to gallons per acre.

This method of sprayer calibration gives sprayer output in gallons per acre when nozzle discharge is measured in ounces over a course length. Use Table 1 to determine course length based on nozzle width in inches.

Step 1

Adjust the sprayer pressure (30 to 40 psi for most sprayers) and check for uniformity. Operate sprayer for one minute and measure spray from each nozzle. Clean or replace any nozzle tip that delivers 5 percent more or less than the output required for a new nozzle in good working condition.

Step 2

Measure the spray band width or nozzle spacing (W) in inches on the boom to determine the course length (D) in feet as shown in column 2 of Table 1. The area to be sprayed must equal 1/128 of an acre. An acre = 43,560ft^2. Therefore, 1/128 of an acre would equal 43,560 divided by 128 = 340 ft^2. If the nozzle spacing = 20 inches then the distance to travel equal 1/128 of an acre would be 204 feet. This can be determined by the following formula:

Or

Or from Table 1. W=20 inches and D=204 feet.

Step 3

Catch the spray from one nozzle while operating the sprayer under field conditions or for the time required to travel the needed distance at a desired speed. Time required to travel distance (D) at selected speeds is shown in Table 1. Time required for other speeds may be calculated with the following formula:

Step 4

Measure the spray collected in ounces. The number of ounces collected is the same as the number of gallons per acre.

Example

You have a sprayer that has 15 nozzles on 30-inch spacing. How would you calibrate it using the 1/128 method?

Using the formula from Step 2 above:

Or from Table 1. W=30 inches and D=136 feet.

Therefore, you would need to time how long it takes for your sprayer to travel 136 feet. Travel this distance several times in the field and get an average time. Perhaps it takes an average of 31 seconds to cover 136 feet.

You would then collect the spray from one nozzle in a container for 31 seconds. Measure the water collected in ounces. The amount collected in

ounces equals gallons per acre. If in 31 seconds you collected 20 ounces, your sprayer output would be 20 gallons per acre.

Determining how much pesticide to add to the spray mixture

The recommendation from the label is to apply 1 quart of 2,4-D per acre.

The sprayer is applying 20 gallons per acre. Therefore, you will need to add 1 quart of 2,4-D to each 20 gallons of water.

Your sprayer holds 200 gallons. So how much pesticide will you need to add to the 200-gallon spray tank?

200 gallons divided by 20 gallons = 10 quarts of 2,4-D

How large an area can be sprayed by your 200 gallon tank?
200 gallons divided by 20 gallons per acre – 10 acres

Table 1. Distance (D) to travel and seconds required for selected speeds when nozzle coverage is (W) inches so that discharge from one nozzle measured in ounces equals gallons per acre.

		Seconds to travel (D) feet at a speed of:			
W(in)	**D (ft)**	**2mph**	**3mph**	**4mph**	**5mph**
5	817	279	186	139	111
6	681	232	155	116	93
7	583	199	133	99	80
8	510	174	116	87	70
9	454	155	103	77	62
10	408	139	93	70	56
11	371	127	84	63	51
12	340	116	77	58	46
14	292	100	66	50	40
16	255	87	58	43	35
18	227	77	52	39	31
20	204	70	46	35	28
22	186	63	42	32	25
24	170	58	39	29	23
26	157	54	36	27	21
28	146	50	33	25	20
30	136	46	31	23	19
32	128	44	29	22	17
34	120	41	27	20	16
36	113	39	26	19	15
38	107	36	24	18	15
40	102	35	23	17	14

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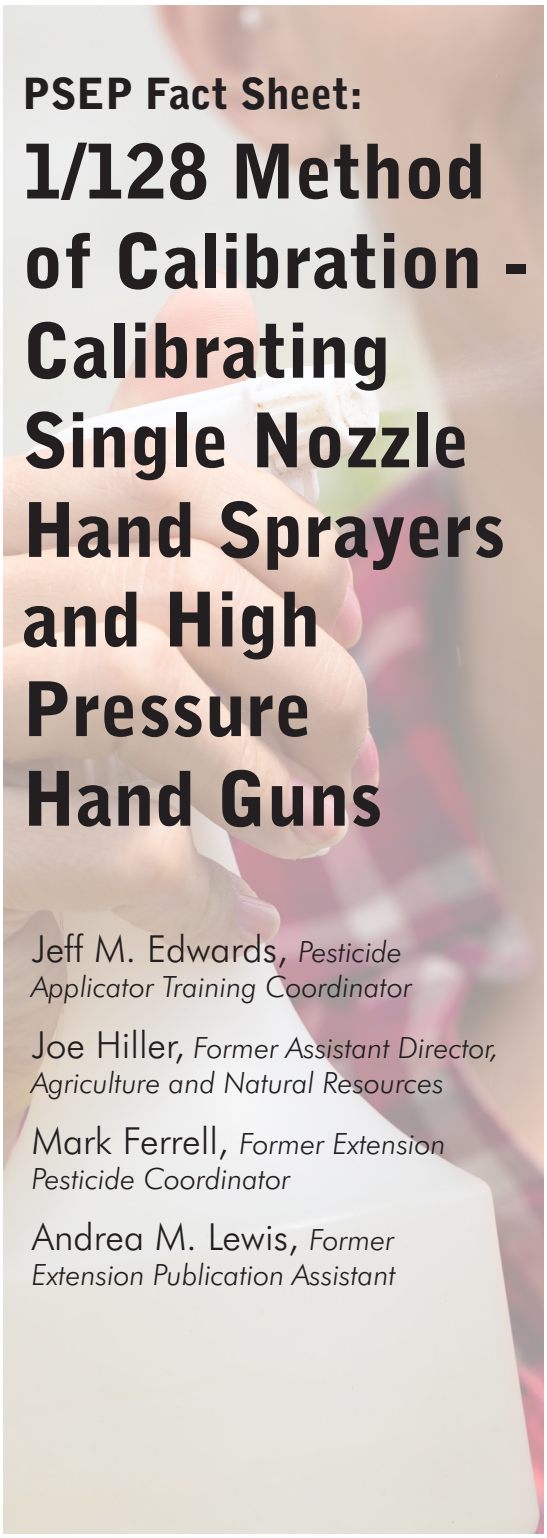

PSEP Fact Sheet:

1/128 Method of Calibration - Calibrating Single Nozzle Hand Sprayers and High Pressure Hand Guns

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Sprayer calibration using the 1/128th method is relatively easy and can be completed very quickly. The 1/128th method is also called the "ounce calibration" method. There is a direct ratio established when determining how much material is applied to 128th of an acre (128 equals the number of ounces in a gallon).

Because a gallon is equal to 128 ounces and the test area to be sprayed is 1/128 of an acre, ounces collected is equal to gallons per acre.

Step 1

Measure out an area equal to 1/128 of an acre. Approximately 340 ft^2 or an area 18.5 feet by 18.5 feet.

Step 2

Measure the time it takes to spray the measured area **with water only**. Repeat several times and take the average time.

Step 3

Spray into a container for the same amount of time it took to spray the measured area. Measure the water collected in ounces. The amount collected in ounces equals gallons per acre.

Example: Hand sprayer

Step 1

Measure area. 18.5 x 18.5 feet = 340 ft^2.

Step 2

Time to spray area = 51 seconds

Step 3

Amount collected = 40 ounces; therefore, 40 ounces = **40 gallons per acre**

Determining how much pesticide to add to the spray mixture

The recommendation is to apply 1 quart of 2,4-D per acre.

The sprayer is applying 40 gallons per acre; therefore, you will need to add **1 quart of 2,4-D to each 40 gallons of water.**

Your sprayer only holds 1 gallon of spray mixture. So how much pesticide will you need to add to the gallon of water?

1 quart (32 ounces) divided by 40 gallons = 0.8 ounces.

1 fluid ounce = 2 tablespoons; therefore, you will need approximately 2 tablespoon of 2,4-D per gallon of water.

1 fluid ounce also = 29.57 milliliters (ml); therefore, if measuring in ml, you will need 0.8 ounces times 29.57 ml per ounce = **24 ml per gallon of water.**

How much area will 1 gallon spray? There is 43,560ft^2 per acre. If 40 gallons will spray one acre then one gallon will spray an area 1/40 that size or 43,560 ft^2 divided by 40 = **1,089ft^2**.

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4 Handling, Storage, and Transportation

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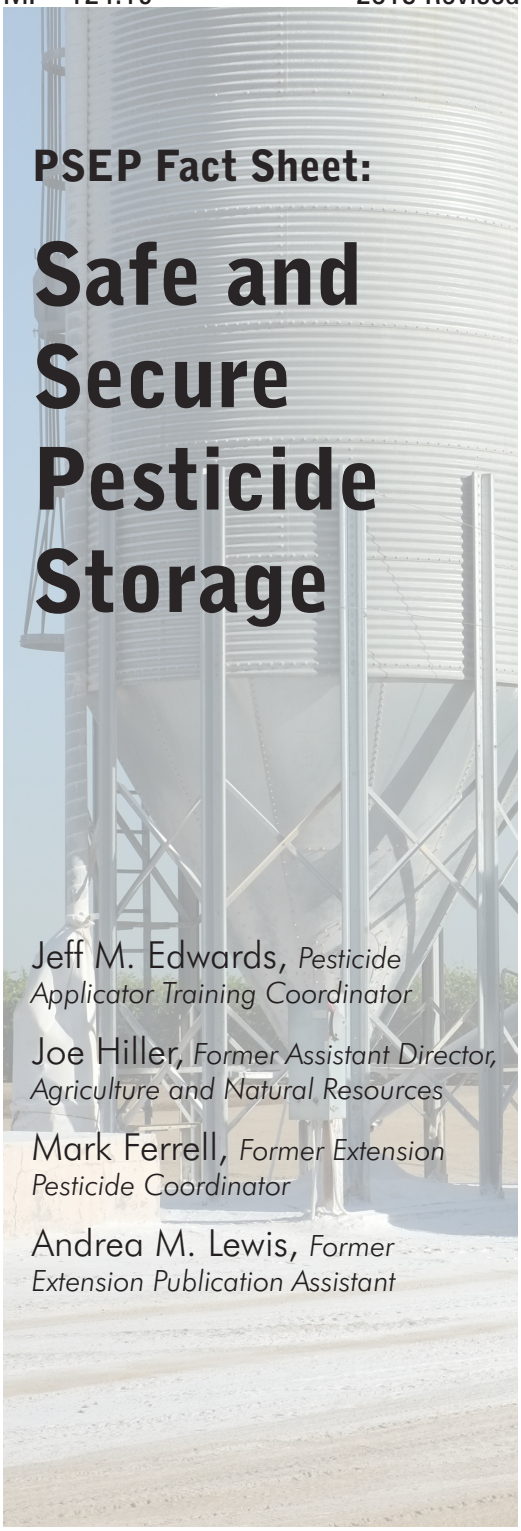

PSEP Fact Sheet:

Safe and Secure Pesticide Storage

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

Always store pesticides in a locked, well-lighted, secure facility. It is important to keep all hazardous materials out of the hands of those who might misuse these chemicals.

- Limit access to a pesticide storage area. Take the necessary steps to keep out unauthorized persons.
- Keep an inventory and check it regularly. Notify authorities immediately of missing chemicals.
- Don't keep excess inventory. Purchase only what is needed and use what is purchased in a reasonable amount of time.
- Have product labels available in the storage facility. Also, have a list of emergency procedures available.
- Let employees know where this information is located.
- Keep the storage facility cool, dry, and well ventilated. Make sure the facility is away from areas likely to flood.
- Post warnings to let emergency personnel and firefighters know they may encounter hazardous chemicals in the storage facility.
- A sealed concrete floor will prevent spills from reaching ground water.
- Sturdy stainless steel shelving is the best choice. For secondary containment, place each container in a disposable foil "turkey roaster."
- Store products by category – keep herbicides separate from insecticides. Store liquid formulations below dry formulations. Keep glass containers on the lowest level. Keep all containers off the floor.
- Keep all pesticides in their original containers with their original labels. Never store a pesticide in a food or drink container.
- Never store feed, seed, fertilizer, veterinary supplies/ medications, or business products in a pesticide storage facility.
- Never let anyone eat, drink, or smoke in a storage facility.
- Never store Personal Protective Equipment (PPE) inside a pesticide storage facility. Keep emergency PPE in another nearby room in case of a spill.
- Keep a spill clean-up kit in a storage facility.

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College of Agriculture and Natural Resources

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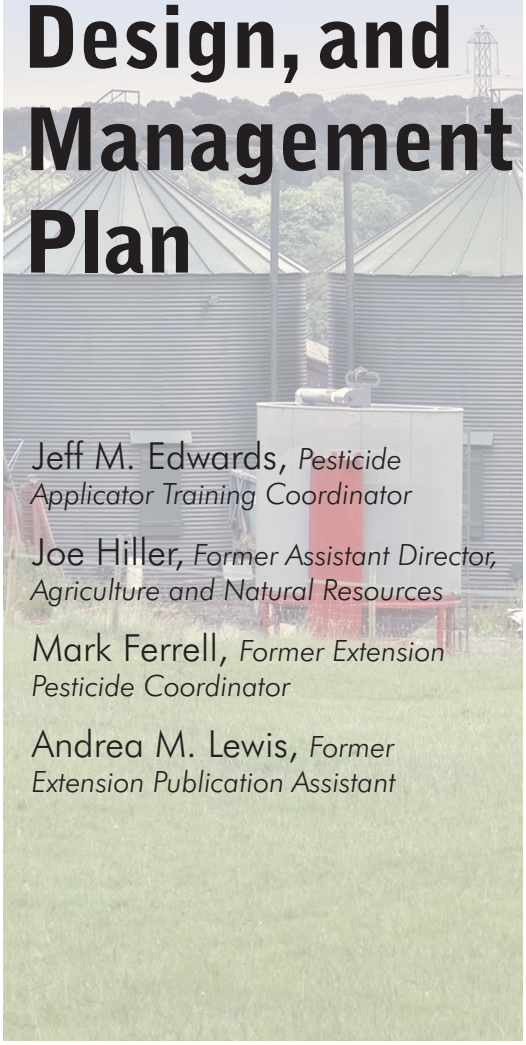
PSEP Fact Sheet:

Pesticide Storage Facility, Design, and Management Plan



Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Safety is the number one reason for maintaining a well-managed pesticide storage facility for workers and the environment. Protecting against spills safeguards humans and the environment. Also, insurance carriers limit policies on environmental damage caused by fires or spills involving agrochemicals. They may also require that certain practices be put in place prior to writing a policy.

A properly designed and managed pesticide facility promotes storage, handling, and disposal practices that enhance worker safety and minimize the risk of point-source contamination. An ideal facility incorporates safety features in all aspects of its design and provides reduced liability.

Proper storage of pesticides reduces the hazards of poisoning or other accidents and helps maintain usefulness. Protecting a pesticide label so it remains legible is important. The label contains the information needed to properly and safely use the product, and it has emergency information in case of an accident. Proper storage also helps reduce the need for pesticide disposal. A separate building for storing pesticides is recommended because of the risk of fire. Suggestions are presented for storage building design, management, and disposal of pesticides. Additional information is available from local UW Extension offices.

Designing Storage Facilities

Electrical

All electrical service must comply with the National Electric Code (NEC) and any applicable state codes. Electrical design for a storage/handling building is covered under the NEC, also referred to as NFPA 70. Use plastic, dust-proof, water-proof electrical boxes and switches. Plastic is not subject to deterioration like metal and can be exposed to limited amounts of water without posing a safety threat. It is important to install ground fault circuit interrupter (GFCI) protection when electricity is in close proximity to water and on all exterior applications.

Use vapor-proof fluorescent or incandescent lighting fixtures. On small buildings, provide an exterior switch to control both the ventilation fan and the lights. An exterior operation light that indicates when the lights and fan are on is a convenient feature. Choose electrical equipment and wiring designed to prevent a spark from igniting a flammable vapor. Avoid sources of high temperature and sparks in storage areas. Duplex outlets, switches, fan blades, and motors are all potential sources of sparks. Use U.L. and National Electric Manufacturers Association (NEMA)-listed anti-spark equipment if available.

Fire

To reduce the hazards associated with pesticide fires, pesticides should be stored in a separate, locked building. Mount an ABC fire extinguisher near the door. Never permit smoking, fires, or welding within the immediate area. Avoid excessive heat, flame, or ignition sources.

Treat a fire in a pesticide storage facility as though it were a flammable liquid or oil fire. Explosions of containerized pesticides are possible during fires. The smoke, fumes, vapors, dusts, and/or liquids produced by all burning pesticides are toxic. DO NOT EXTINGUISH BURNING PESTICIDES WITHOUT PROPER PROTECTIVE CLOTHING AND A SUPPLIED AIR DEVICE OR SELF-CONTAINED BREATHING APPARATUS!

Heating

An insulated, heated building may be needed if pesticides are subject to freezing. Provide heat by low-pressure steam, hot water, or electric heaters that are UL-listed for Class I hazardous locations. Never use or allow open flames or smoking in storage or handling areas. Install a small heating system to maintain sufficient temperatures in the winter to assure pesticide viability and extend shelf life. In some cases, a small electric heater can provide zone heat more effectively than heating a large storage structure.

Mixing Areas

Consider mixing **all** pesticide formulations outside. If too windy or wet to mix the chemicals safely, then it is too windy or wet to apply the chemicals. **Always wear a respirator when mixing chemicals as per manufacturers' instructions!** If indoor mixing is used, a down-draft ventilation hood at the back of the mixing table can be used to remove dust and vapors. Downdraft hoods are superior to updraft hoods because they prevent a user's face from being exposed to chemicals.

Rinse Pad and Collection Tank

Slope the rinse pad 2 percent to the center of the pad or far enough away from any side or end so the rinse water (rinsate) will not wash off the pad.

Use berms or curbs whenever possible to contain the rinsate. The rinse pad should have a sealed surface to provide chemical resistance.

Pipe or plumbing must not pass through the concrete of the rinse pad.

The water supply must have back-flow prevention installed.

Catch both rinsate and precipitation from the rinse pad. The collection system must be designed to contain at least 125 percent of the volume of the largest chemical tank that will be placed on the structure.

Use steel-grated floor drains to allow drainage to concrete collection sumps. A sump is used to collect rinsate and wash water from the pad and to allow the reuse of subsequent sprayer fillings with the same chemical. Prevent the tracking of mud or chemicals off the pad by wheel traffic by properly washing the equipment and pad.

To use the rinse pad, drive the sprayer onto the concrete pad and make sure that the sump drain valve (if installed) is locked in the closed position. Any leftover, field-strength chemical and rinse water from the sprayer drain valve should be pumped into a marked rinsate tank. Any spills can be washed into the sump for later recovery. Wash water should be collected from the exterior wash of the spray equipment, tank, and plumbing clean-out.

The pad should be washed and then rinsate collected and transferred to storage or nurse tanks located on the pad before a change in pesticides or after field operations on a daily basis. Sediment that collects in the sump should be removed prior to switching from one chemical to another. The sludge contains pesticides and must be disposed of properly.

After rinsing, rinsate should be collected and pumped to above-ground storage tanks. Store the rinsate from each pesticide or crop separately. Rinsate can be stored temporarily in various types of holding tanks including mobile nurse tanks. A good choice, however, is one or more 300-gallon, cross-linked polyethylene or fiberglass tanks. Liquid levels can be easily seen through these types of tanks. Consider mounting the rinse water storage tanks three to five inches above the concrete floor to prevent corrosion and to aid in detecting leaks. Pumps and piping should be

aboveground, too, and contained within the rinse pad area.

More than one rinse water tank may be needed. By separating rinse water by pesticide use into different tanks, it can be used later as make-up water the next time the product or a compatible chemical is sprayed. Caution should be used to follow label instructions and mix only label-compatible agrochemicals. Rinsate used for make-up water should not exceed 20 percent of the volume of the spray tank.

For example, if 50 to 75 gallons of water are used to thoroughly clean a sprayer in which 6 to 10 gallons of spray may be left, the rinsate will be diluted to about 10 percent of the field strength. Diluting it again at four parts water to one part rinsate means only 1 to 2.5 percent of the original field strength.

It is recommended that storage tanks be mounted on a level area at the back of a concrete pad within concrete walls high enough to contain an amount 10 percent greater than the volume of the tank should a severe leak occur. A separate sump in the containment area is needed to handle rainfall and potential rinse-water spills. It is important to keep the sump pumped dry so rainwater and snow will not become a handling problem. Sumps should be checked and rinsed regularly.

Site Selection and Site Work

Locate a facility away from water sources that could become contaminated by an accidental spill. Choose a site that has not been used for chemical storage, mixing, loading, or equipment rinsing (there is concern about possible soil contamination). If this is not possible, take precautions to remove contaminated soil or otherwise decontaminate the site before constructing a rinse pad.

Consider removing all topsoil, organic matter, and debris from the site and excavating it to a sufficient depth to allow the concrete slab and sub-base to be situated on firm, undisturbed soil. Consider using crushed rock compacted in 6-inch layers.

Storage building construction should comply with local and state codes. Secure all necessary permits prior to construction.

Ventilation

Consider using constant, low-rate (one air change per hour) mechanical or natural ventilation during non- occupancy and supplemental ventilation when a facility is in use. A two-speed fan can be utilized to provide base-rate ventilation during non-occupancy, and a high speed can be used for automatic, forced-air exhaust during occupancy. The high capacity of the fan(s) should provide approximately seven air changes per hour. Because of fire hazards, fan blades should be non-sparking.

Consider designing fresh-air intakes and tempering the air by drawing it through the attic, thereby reducing the heating requirements. Be careful to avoid dead-air spaces where ventilation is inadequate.

Exhaust fans mounted in the sidewalls should have duct work to allow exhausting air at a level 15 inches above the floor. This will allow vapor or dust to be vented away from an occupant's face.

Water Source

Consider using an elevated tank located next to a chemical storage building for filling sprayers by gravity flow. A water storage tank needs to be filled by a water line from a site away from the pad. The bottom of a storage tank should be higher than the top level of the sprayer tank to prevent back flow. Ensure that a hose bib from a sump cannot be mistaken for drinking water.

Worker Safety

Provide eyewash and deluge shower to rinse chemicals from the eyes, face, and body. Other necessary items include a first-aid kit and spill-response kit.

Potential Compliance Problem Questions

Is the drain in a storage area?

Is food or feed stored with pesticides?

Is the container cleaning area separate from the mixing area?

Is the facility built on a site previously used for mixing and loading?

Is the equipment rinse water or rinsate stored underground?

Pesticide Storage Management Plan

Pesticides come in many types and formulations.

The most common types are herbicides, insecticides, fungicides, rodenticides, and fumigants, but there are many more. Pesticides can be formulated as concentrates or as liquids that are ready to use; as solids such as dusts, wettable powders, and granules; or as gases in pressurized cylinders. Packaging materials for pesticides may include metal, glass, plastic, and paper.

General Precautions

Store pesticides in their original, labeled containers and never in beverage, food, open, or other containers that could be mistaken for something else.

Keep pesticides out of the reach of children, pets, and livestock. A well-ventilated, dry, locked, and labeled cabinet or storage room is recommended.

Separate pesticides from foods, feeds, drugs, or other edible products and their packaging materials.

Separate pesticides from protective clothing and equipment.

Keep pesticides away from sources of flame or ignition and away from sources of water. Consider the potential for flooding, fire, or other disasters.

Store pesticides with lids tightened and periodically check for leaks or other problems.

Take precautions to keep labeling intact and legible. A label is a legal document, and if it becomes illegible, legal use of the product could be compromised.

Keep different classes of pesticides separate from each other (herbicides separate from insecticides, etc.).

Inventory

Recommended storage procedures include keeping an accurate and current inventory record that indicates product storage information such as special storage and handling needs and dates of arrival. Placing dates on product packaging or labels can be useful but don't obscure label information.

Keep any applicable emergency response information with an inventory in case of poisoning, fire, or spill. Keep a copy in an area separate from the storage facility. Pay special attention to volatile agricultural chemicals both for their shelf lives and for possible contamination of other products stored in the same area. Send a copy of the emergency response information to a local fire control agency with a map showing the locations of storage areas. Rotate the inventory to maximize shelf life.

Shelf Life

The shelf life of a pesticide is the storage time over which the product remains useful. To remain useful, a product must still be effective for its intended purpose and still be in a condition that allows it to be applied as directed. Shelf life is a function of several variables such as time, sensitivity (temperature, moisture, light), formulation stability (dry, liquid, concentrated, ready to use), and container integrity (metal, glass, plastic, paper). Shelf-life protection for pesticides includes: 1) storage in the original container tightly sealed, 2) storage in a cool, dry, and ventilated area, 3) keeping liquids above their recommended minimum temperatures, and 4) keeping solids from becoming damp.

As a general rule of thumb, two years is considered the maximum storage life for most pesticides although there are many exceptions to this. The shelf life of some specific pesticides follows:

Cold Weather Precautions

Pesticide labels have a section on "Storage and Disposal." Products that are frozen should be warmed gradually to the indicated temperature and then rolled or shaken to re-dissolve crystals and achieve proper mixing. All products that have been in prolonged storage should be rolled or shaken to obtain uniform mixing. A simple test of liquid pesticides can help determine if they have been frozen and may have reduced efficacy.

Two tablespoons of a liquid concentrate should be added to a quart jar that is about three-fourths full of water. The mixture should be shaken thoroughly and allowed to sit for an hour. If the mixture remains uniformly milky, the pesticide is probably still good. If it separates to show a layered effect, it may have reduced efficacy. Contact the manufacturer for more information.

Cold Weather Storage and Handling of Liquid Pesticides

Freezing of liquid pesticides can result in separation of the active ingredients from the solvents or emul-

sifiers or inactivation of emulsifiers, which may lead to crystallization or coagulation of the pesticide. Applicators should know which pesticides can be frozen and which cannot. Techniques for thawing and redissolving are also important since a pesticide, once frozen, can plug spray equipment, result in poor product performance, and/or damage crops if the proper thawing and mixing procedures are not followed.

Many pesticides can freeze with no adverse effects to the pesticide, although separation of the active ingredient and solvent will occur. Certain steps must be followed before using a pesticide that has been frozen. First, the product must be thawed. Before attempting to thaw a frozen pesticide, however, the container should be checked to make sure it is not ruptured or cracked from the expansion of the frozen liquid. If sound, the container should be brought to room temperature (placed in a heated room or the south side of a sunny building away from children, livestock, and pets) for the thawing process, which may take several days. Once the liquid has thawed, the container can be rolled, shaken, or otherwise agitated to get the contents into a uniform suspension. The container should also be inverted several times to ensure the product is completely dissolved. Pesticide manufacturers caution that if a pesticide cannot be totally redissolved (crystals are still present), the pesticide should not be used.

Storage Conditions

The freezing point of many pesticides is lower than 32 degrees Fahrenheit due to the hydro-carbon solvents or inert ingredients. Pesticides that cannot be frozen should be placed in a heated or adequately insulated area to avoid low temperatures. Wettable powders and granules, as a rule, are not affected by low temperatures. These formulations should be stored in a dry place as moisture may promote caking or lead to certain chemical changes reducing their effectiveness. Products formulated in water-soluble bags require special winter storage. These bags have a high affinity for moisture and become brittle when frozen. They will break open if handled when brittle. It is important that they be stored in heated facilities.

Before storing pesticides for the winter, the applicators need to read the pesticide label.

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The information in this fact sheet was modified from: "PESTICIDE STORAGE FACILITY DESIGN AND MANAGEMENT PLAN" January 1999 AG/Pesticides/04 by Stephen E. Poe, Extension Agricultural Engineer, Howard M. Deer, Extension Pesticide Specialist, and Kitt Farrell-Poe, Water Quality Specialist, Utah State University, Logan, UT 84322-4620

Common (Trade)	Shelf Life	Comments
atrazine (Aatres) 80W	At least 5 years	Under proper storage conditions
atrazine (Aatres) 4L	2 years	Under proper storage conditions
bacillus thuringiensis (Di-Pel Thuricide)	2 years	Store below 105° F
barban (Carbyne)	At least 1 year	Under proper storage conditions
benlate (Benomyl) WP	2 years	Decomposes if exposed to moisture
captan (Orthocide) WP	3 years	Under proper storage conditions
carbaryl (Sevin) WP	5 years	Remains effective up to 5 years
DCPA (Dacthal) WP	At least 2 years	Under proper storage conditions
diazinon	5 to 7 years	Keep liquids sealed and solids dry
dicamba (Banvel)	At least 1 years	Under proper storage conditions
dichlobenil (Casoron) 4G	At least 2 years	Keep dry, sealed and cool
dinocap (Karathane	5 years	Under proper storage conditions
disulfoton (DiSyston)	2 years	Under proper storage conditions
fenbutatin-oxide (Vendex) WP	2 years	Under proper storage conditions
glyphosate (Roundup)	At least 2 years	Store below 140°F
malathion WP	2 years	Decomposes under high temperatures
methoxychlor WP	Indefinite	Under proper storage conditions
oryzalin (Surflan) WP	3 years	Mix well before using
oxydemeton-methyl (Meta-systox-R)	2 years	Under proper storage conditions
paraquat (Gramoxone)	Indefinite	Do not allow to freeze
phosmet (Imidan) WP	2 to 3 years	Under proper storage conditions
pronamide (Kerb) WP	At least 2 years	Under proper storage conditions
propargite (Omite)	At least 2 years	Under proper storage conditions
simazine (Princep, Aquazine)	3 to 5 years	Under proper storage conditions
thiram WP	4 years	Keep dry, sealed, below 100°F
trifluralin (Treflan)	3 years	Under proper storage conditions

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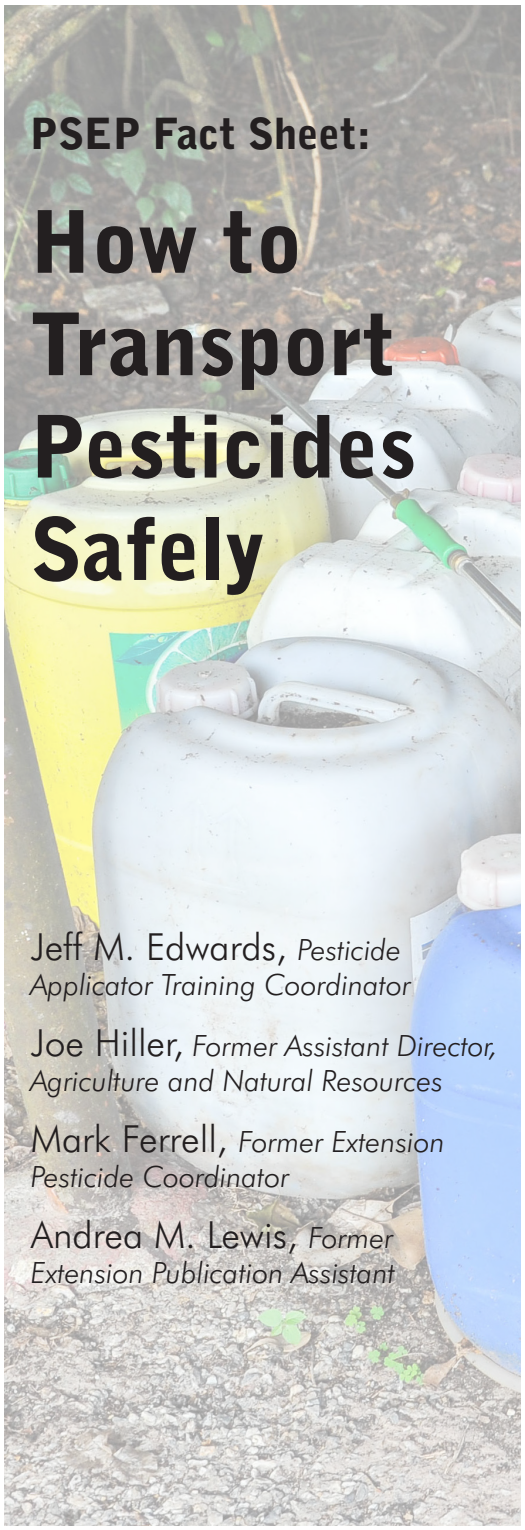

PSEP Fact Sheet:

How to Transport Pesticides Safely

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Use this checklist to make sure you follow all the correct steps for transporting pesticides safely from the supplier to the storage or application site.

Inspect the vehicle

( ) Remove sharp objects from the truck bed

( ) Check lights, tires, mirrors, steering, and brakes

Put safety equipment in the vehicle

( ) Soap and water for cleaning hands, water for flushing eyes or skin

( ) Protective clothing, chemical-resistant boots and gloves

( ) Respirator for toxic fumes

( ) Goggles or face shield for eye protection

( ) Shovel to build dirt dikes

( ) Absorbent material such as kitty litter for small spills

( ) Decontamination solution (bleach)

Make sure you have:

( ) Your pesticide applicators license
( ) A tarpaulin in case of rain
( ) Emergency telephone numbers

Do's and don'ts during transportation

DO NOT transport pesticides in the passenger compartment of any vehicle.

DO NOT load edible food or feed into the same cargo area with pesticides.

DO NOT stack heavy pesticides containers on top of light ones.

DO remain alert.

DO drive with extreme caution.

What to do if a spill occurs

1. **Secure the area** - keep people at a safe distance from the spill.
2. **Put on safety equipment** to protect your health, or even to save your life.
3. **If possible, stop the leak** - without endangering yourself or others. To stop a small spill, use absorbent material and contain it with a dirt dike. Don't use water - it will only spread the spill.
4. Notify the local fire department.

READ AND FOLLOW LABEL DIRECTIONS!

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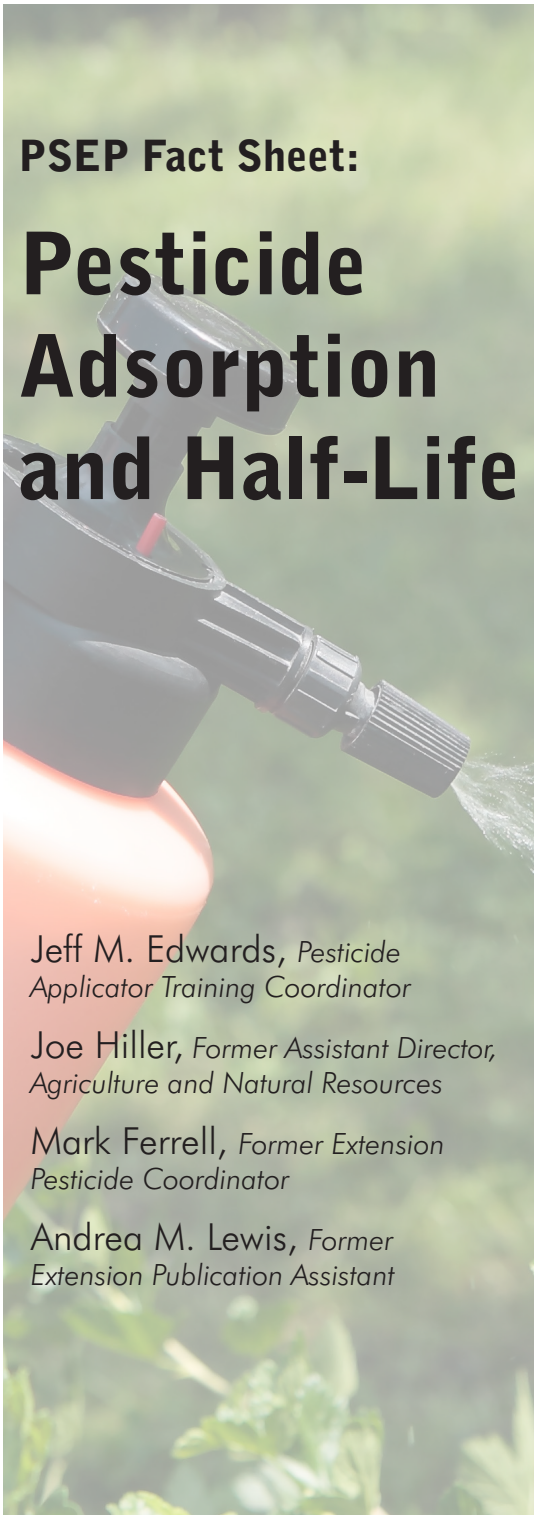

PSEP Fact Sheet:

Pesticide Adsorption and Half-Life

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

This chart lists the soil adsorption coefficient (Koc) and soil half-life (T1/2) for commonly used pesticides. A soil adsorption coefficient can be considered an index for pesticide mobility, but one must also take into account a pesticide's half-life. For instance, the top three pesticides in the table below have relatively low soil adsorption coefficients, which implies that they have the potential to leach. However, they also have short half-lives so generally they do not persist long enough in the soil to reach ground water. Chart numbers are useful for comparing relative differences between pesticides and should not be construed as absolute values.

The larger the Koc, the more strongly a pesticide is held to soil organic matter and the less likely it will leach. The Koc value represents the adsorption of a pesticide on soil normalized by organic matter to provide a single representation of a particular pesticide for all soils. For this reason, the uncertainty could be plus or minus twice the listed value.

Half-life is the period of time it takes for one-half of the amount of pesticide in soil to degrade. Each half-life that passes reduces the amount of pesticide present in soil by one-half, i.e. 1 to 1/2 to 1/4 to 1/8 to 1/16, etc. Half-life can vary due to soil microbial populations, soil moisture, soil temperatures, and other factors. These numbers represent typical values from scientific literature. Non-persistent pesticides have a half-life of 30 days or less, moderately persistent pesticides have a half-life of 30 to 99 days, and persistent pesticides have a half-life greater than 100 days.

Common Name/ Trade Name	Soil Adsorption Coefficient (µg/g) Koc	Half-Life (Days) T ½
acephate/Orthene	2	3
dicamba/Banvel	2	14
methamidophos/Monitor	5	6
picloram/Tordon	16	90
2,4-D/Weedon	20	10
dimethoate/Cygon, Dimate	20	7
carbofuran/Furadan	22	50
oxamyl/Vydate	25	4
aldicarb/Temik	30	30
bromacil/Hyvar	32	60
1,3-dichloropropen/Telone	32	10
bentazon/Basagran	34	20
metalaxyl/Apron	50	70
hexazinone/Velpar	54	90
terbacil/Sinbar	55	120
ethopropo/Mocap	70	25
methomyl/ Lannate	72	30
tebuthiuron/Spike	80	360
atrazine/Aatrex	100	60
acifluorfen/Tackle	113	14
simazine/Princep	130	60
prometon/Pramitol	150	500
alachlor/Lasso	170	15
cyanazine/Bladex	190	14
captan/Orthocide	200	3
eptc/Eradicane	200	6
metolachlor/Dual	200	90
carbaryl/Sevin	300	10
linuron/Lorox	400	60
diuron/Karmex	480	90
terbufos/Counter	500	6
norflurazon/Solicam	600	90
oryzalin/Surflan	600	20
fonofoa/Dyfonate	870	40
azinphos-methyl/Guthion	1,000	10
diazinon/Knox-Out, D.Z.N.	1,000	40
phorate/Thimet	1,000	60
chlorothalonil/Bravo, Daconil	1,380	30
malathion/Cythion, Fyfanon	1,800	1
benomyl/Benlate	1,900	240
ethalfluralin/Sonalan, Curbit	4,000	60
fenvalerate/Ectrin	5,300	35
fluzzifop-p-butyl/Fusiland	5,700	15
chlorpyrifos/Lorsban	6,070	30
trifluralin/Treflan, Tri-4	8,000	60
diclofop-methyl/Hoelon	16,000	37
glyphosate/Roundup	24,000	47
paraquat/Gramoxone	1,000,000	1,000

Source: SCS/ARS/CES, Pesticide Properties database for Environmental Decision Making, August 10, 1994.

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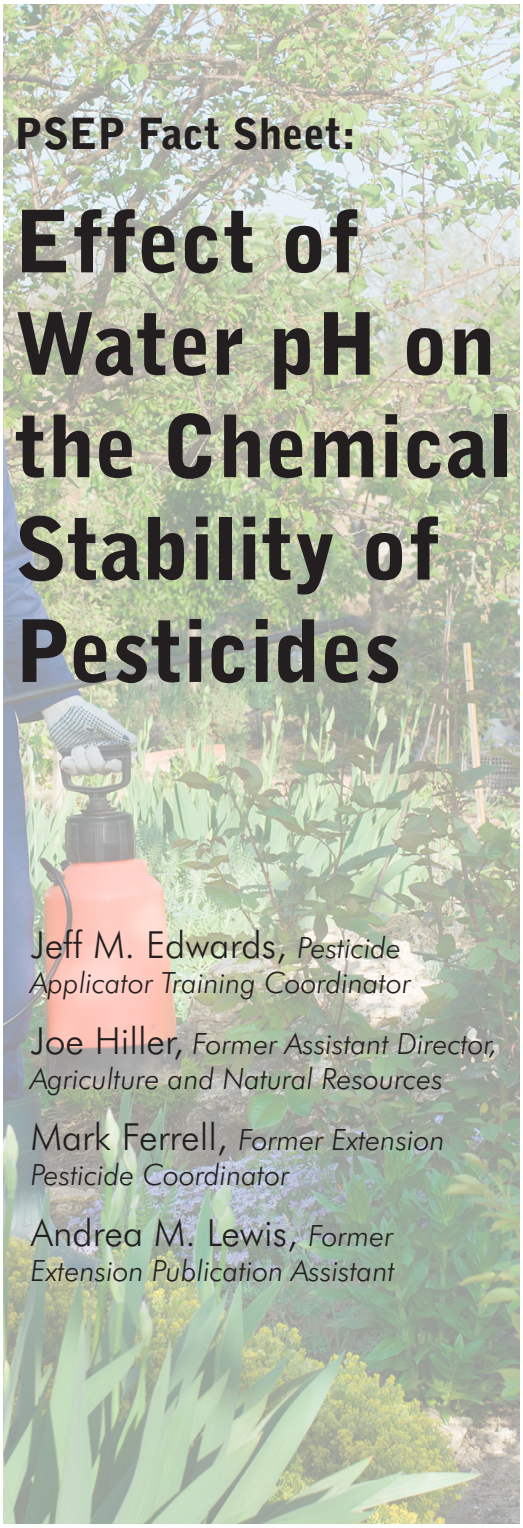

PSEP Fact Sheet:

Effect of Water pH on the Chemical Stability of Pesticides

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Most pesticide formulations such as dry flowables, emulsifiable concentrates, and wettable powders are designed to be diluted with water as the carrier. A water pH higher than 7 can cause some pesticides to undergo degradation or chemical breakdown, a process known as hydrolysis. In general, insecticides are much more susceptible to hydrolysis than are fungicides, herbicides, defoliants, or growth regulators. Organophosphate and carbamate insecticides are more susceptible than chlorinated hydrocarbon insecticides. Some pyrethroids exhibit susceptibility to hydrolysis.

Tables reporting the pH of water sources across the U.S. list only a few states that have water with a pH below 7. The remainder all have sources with varying degrees of alkalinity. Both surface and ground water supplies usually contain sufficient natural alkalinity to produce pH levels between 7 and 9.

Some pesticides hydrolyze very rapidly. The hydrolysis rate can be rapid in a pH range of 8 to 9. For every pH point increase, the rate of hydrolysis will increase by a factor of about 10. The severity of losses due to alkaline hydrolysis is governed by the degree of water alkalinity, the susceptibility of a pesticide, the amount of time a pesticide is in contact with water, and the temperature of the mixture.

The solution to the problem is to lower the pH of water to the optimum range of 4 to 7 before mixing it with a pesticide. Do this by adding the recommended rate of a buffering or acidifying agent. The buffering effect starts from the time of mixing in the tank and continues until the water has evaporated from a spray droplet lying on a leaf. Buffering does not affect the residual activity of a pesticide. Some materials, such as fixed copper fungicides like basic copper sulfate, copper oxide, and Bordeaux mixtures, should not be buffered because an acid solution may cause the metals to solubilize and produce a phytotoxic effect when sprayed on plants. Products used to acidify tank solutions may be acidifying agents used alone or in combination with surfactants or fertilizers.

A pH meter is the most satisfactory and accurate method of determining the pH of water. The use of test papers such as litmus paper can be unreliable and can be as much as 2 pH points in error. There are available liquid color indicators (example: Bromothymol Blue) that can indicate pH to within a half point. Water sources, both surface and ground, can and do change in pH with the passage of time. A change in pH is usually toward a more alkaline condition.

In summary, know the pH of water that is to be used with pesticides and the susceptibility of the pesticides to hydrolysis. Do not mix pesticides until just prior to the time of application. Mix only quantities that can be used within the shortest time possible. If conditions dictate, adjust the pH of the water to an optimum level.

Common Name	Trade Name	Half-Life* at Different pH values**
acephate	Orthene	pH5 = 40 days, pH7 = 46 days, pH9 = 16 days
azinphos-methyl	Guthion	pH5 = 17 days, pH7 = 10 days, pH9 = 12 hours
bendiocarb	Ficam, Turcam	pH7 = 4 days, pH9 = 45 minutes
captan	Orthocide	pH7 = 8 hours, pH8 = 10 minutes, pH10 = 2 minutes
carbaryl	Sevin	pH7 = 24 days, pH8 = 3 days, pH9 - 1 day
carbofuran	Furdan	pH7 = 40 days, pH8 = 5 days, pH9 = 3 days
chlorothalonil	Bravo, Daconil	Stable below pH7, pH9 = 38 days
chlorpyridos	Dursban, Lorsban	pH7 = 35 days, pH8 = 22 days, pH10 = 7 days
diazinon	Knox-Out, D.Z.N.	pH5 = 14 days, pH7 = 70 days, pH9 = 90 days
dimethoate	Cygon, Dimate	pH4 = 21 hours, pH6 = 12 hours, pH9 = 1 hours
disulfoton	Di-system	pH5 = 60 hours, pH6 = 32 hours, pH9 = 7 hours
malathion	Cythion, Fyfanon	pH7 = 3 days, pH8 = 10 hours, pH10 = 2 hours
methomyl	Lannate	pH6 = 54 weeks, pH7 = 38 weeks, pH8 = 20 weeks
photmet	Imidan	pH7 = 12 hours, pH8 = 4 hours, pH10 = 1 minute
propargite	Omite, Comite	pH3 = 17 days, pH6 = 331 days, pH9 = 1 day
tricholoran	Dylox	pH6 = 4 days, pH7 = 6 hours, pH8 = 1 hour

*Half-life is the period of time it takes for one-half of the amount of pesticide in water to degrade. Each half-life that passes reduces the amount of pesticide present in water by one-half, i.e. 1 to ½ to ¼ to 1/8 to 1/16, etc.
** These values are generalized estimates and reflect trends, but half-life periods may vary considerably. Hydrolysis depends on other factors besides the pH of a solution including temperature, formulation, and other pesticides and adjutants that are in a spray tank.
Source: Loveland Industries, Inc. 11/91 (Wilbur-Ellis 5/93)

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5 FIFRA Amendments

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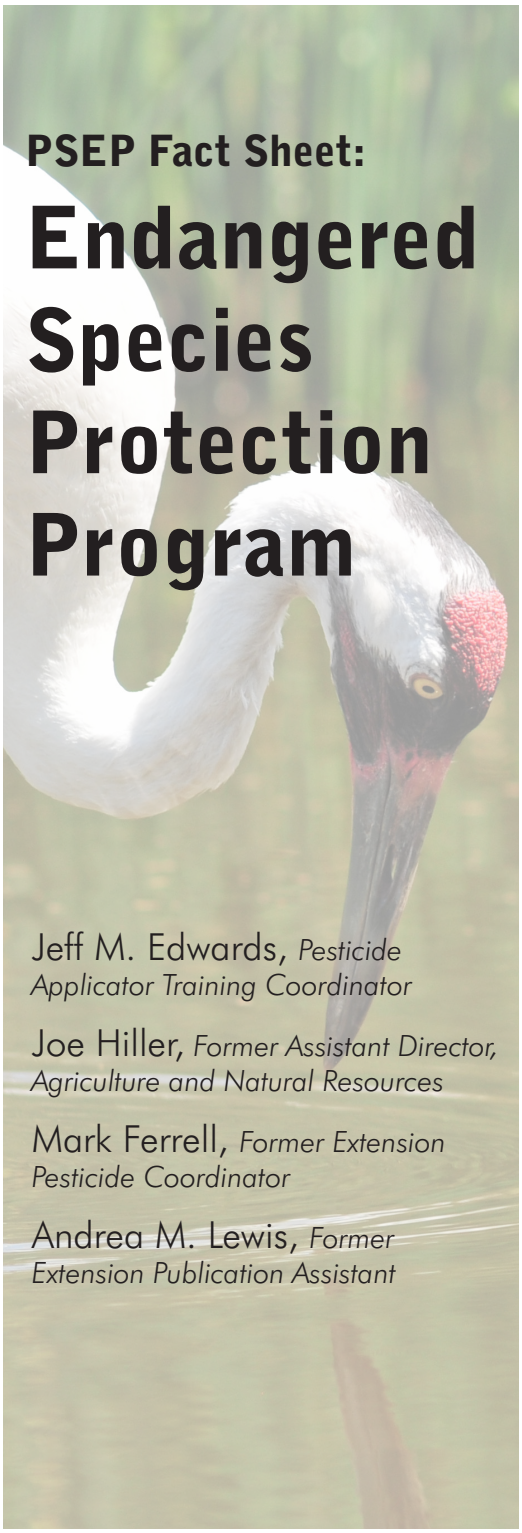

PSEP Fact Sheet:

Endangered Species Protection Program

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

Protecting endangered and threatened species and restoring them to a secure status in the wild is the primary objective of the endangered species program of the U.S. Fish and Wildlife Service, an agency of the Department of the Interior. Responsibilities of the endangered species program include:

1. Listing, reclassifying, and delisting species under the Endangered Species Act;
2. Providing biological opinions to federal agencies on their activities that may affect listed species;
3. Overseeing recovery activities for listed species;
4. Providing for the protection of important habitat; and
5. Providing grants to states to assist with their endangered species conservation efforts.

Current list and status of endangered species in Wyoming can be found at www.fws.gov/wyominges/pages/species/species_endangered.html

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6 Other Application Procedures

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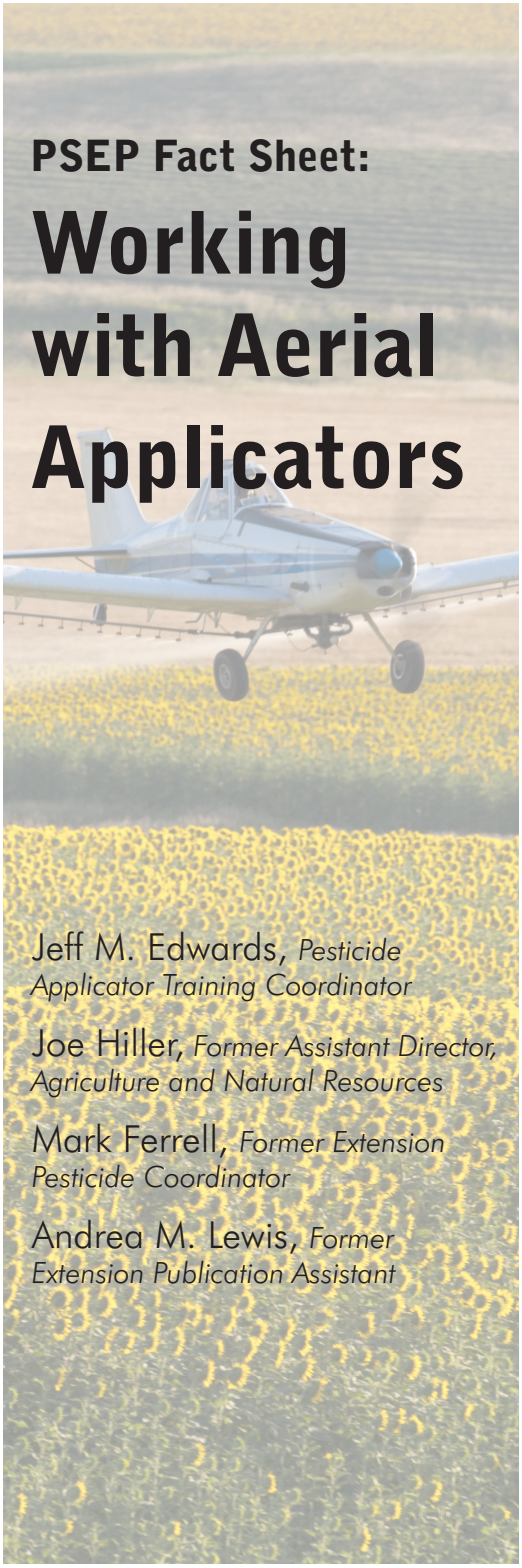


PSEP Fact Sheet:

Working with Aerial Applicators

Jeff M. Edwards, *Pesticide Applicator Training Coordinator*

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

Aerial application of seeds, fertilizers, and pesticides play an important role in agriculture. The value of aerial application, however, is often lost on the general public. To many, aerial spraying symbolizes a public health risk and a source of concern, especially in areas where farms and ranches border suburban homes. Consideration of environmental protection and relationships with neighbors can often play an important role in minimizing possible concerns.

Planning

The following are considerations when working with aerial applicators:

Draw a map

Identify the fields to be treated and any crucial areas to avoid. Keep the map simple and easy to read during flight, with boundary landmarks clearly identified. Review the map with the pilot and carefully identify:

- Hazards to flight such as power lines, antennas, or wire fences
- Ponds, creeks, streams, or wetlands
- Sensitive or organically grown crops
- Beehives
- Sinkholes
- Buildings or neighbors close to fields that are being sprayed

Notify neighbors

Let neighbors know that an aerial applicator will be spraying. Give them as much notice as possible, especially if they keep beehives, have fieldworkers near the application site, or grow sensitive or organic crops. Be prepared to tell them what chemical the applicator will be spraying, its characteristics, and why the treatment is important. Check with a pesticide dealer or sales representative for this information. Good public relations can be as simple as a handshake or a phone call. Long before an aerial application is needed, let neighbors know that safety and environmental protection is a priority. Show them field maps and plants. They will be much more comfortable with an aircraft working nearby if they know someone who is knowledgeable is in charge of the operation.

Work closely with the pilot

Professional pilots are experts at interpreting the effects of changing weather conditions on operational plans of each job. Be sure to discuss this with the pilot and establish whose responsibility it is for making decisions on whether or not to spray. When hiring an aerial applicator, be sure to clarify who will rinse and dispose of empty containers, who will post reentry signs where required, where mixing/loading and plane rinse-out will occur, and who has responsibility for errors or misapplication.

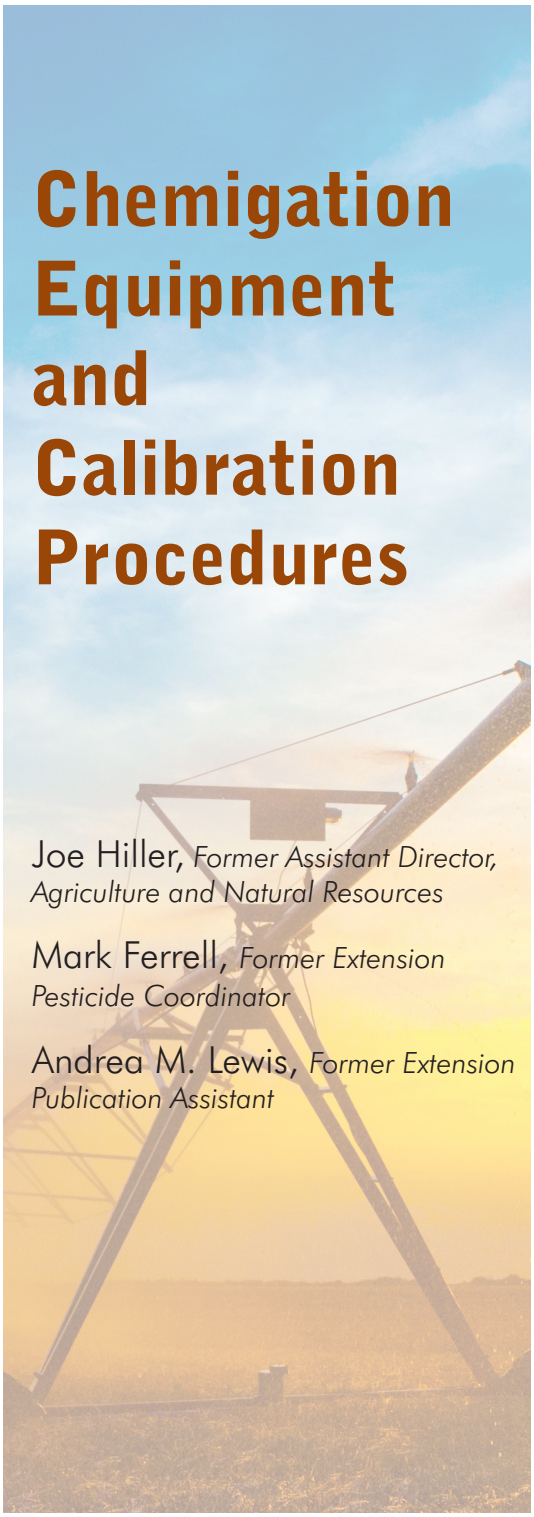
References and Resources

Working With Aerial Applicators. Alliance for a Clean Rural Environment, Kansas City, Missouri.

Working With Aerial Applicators. E.J. Buffington and S.K. McDonald. Pesticide Fact Sheet #127. Colorado State University, Cooperative Extension. 2001

B-1023 2013 Revised

Chemigation Equipment and Calibration Procedures



Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

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College of Agriculture and Natural Resources

This bulletin is one of two covering chemigation. Companion bulletin B-1024 is titled "Chemigation Practices for Wyoming." Irrigation systems today are being used not only to apply water to crops, but also fertilizers, herbicides, insecticides, fungicides, nematicides, and plant growth regulators (PGR). The process of applying chemicals to crops through irrigation water has been termed chemigation

The purpose of this bulletin is to provide information needed to chemigate safely and effectively. It is intended to supplement operator's manuals for irrigation and chemical injection systems. This bulletin will focus on equipment and calibration procedures for center pivot sprinkler systems.

Chemigation Equipment

A correctly engineered chemigation system has the following components:

- Irrigation pumping plant
- Chemical injection pump
- Chemical storage tank with agitator
- Calibration devices
- Backflow-prevention system
- Related safety equipment

Chemical pollution of ground water or surface water can occur if: 1) water backflows through the chemical injection system and overflows the chemical supply tank; 2) mechanical or electrical failure causes the irrigation pumping plant to shut down, which allows a portion of the water and chemical mixture to flow direction into the irrigation water supply; 3) over-application occurs due to improperly calibrated equipment; or 4) leaking valves, casings, pipelines, and manifolds are used. The second situation is the most serious. If the chemical injection equipment continues to operate after the irrigation pumping shuts off, the remaining chemical solution could be pumped into the irrigation pipeline. This may allow it to flow directly into the water source or onto the ground and then into groundwater.

The chemigation safety equipment required by the Environmental Protection Agency (EPA) Label Improvement Program (LIP) is the minimum required in every state. States may require more equipment than the EPA lists in its LIP, but never less. Wyoming currently has no requirements concerning chemigation equipment. Since the EPA published its first list of required safety equipment under the LIP, newer and more up-to-date equipment has been developed. The EPA has published updated to the original list of approved safety equipment. Original devices and approved alternative are given below. Figure 1 and 2 illustrate minimum requirements for anti-pollution devices, and arrangements of chemigation equipment for engine-driven and

motor-driven setups, respectively. Contact the EPA, Region 8 Office, to get information on the most up-to-date regulations and approved safety equipment (see Further Information). The following list is current as of January 1995.

List of Alternative EPA-Approved Chemigation Safety Equipment

Original Device

Functional, normally closed, solenoid-operated valve located on the intake side of the injection pump.

Alternative Device 1

Functional spring-loaded check valve with a minimum of 10 pounds per square inch (psi) cracking pressure. The valve must prevent irrigation water under operating pressure from entering the pesticide injection line and must prevent leakage from the pesticide supply tank on system shutdown. This valve must be constructed of pesticide-resistant materials *[Note: this single device can substitute for both the solenoid-operated valve and the functional, automatic, quick-closing valve in the pesticide injection line.]*

Alternative Device 2

Functional, normally closed, hydraulically operated check valve. The control line must be connected to the main water line so that the valve opens only when the main water line is adequately pressurized. This valve must prevent leakage from the pesticide supply tank on system shutdown. The valve must be constructed of pesticide-resistant materials.

Alternative Device 3

Functional vacuum-relief valve located in the pesticide injection line between the positive displacement pesticide injection pump and the check valve. This alternative is appropriate for only those chemigation systems using a positive displacement pesticide injection pump and is not for use with venturi injection systems. This valve must be elevated at least 12 inches above the highest fluid level in the pesticide supply tank and must be the highest point in the injection line. The valve must open at 6 inches water vacuum or less and must be spring-loaded or otherwise constructed so that it does not leak on closing. It must prevent leakage from the pesticide supply tank on system shutdown. The valve must be constructed of pesticide-resistant materials.

Original Device

Functional main water line check valve and main water line low pressure drain.

Alternative Device 1

Gooseneck pipe loop located in the main water line immediately downstream of the irrigation water pump. The bottom side of the pipe at the loop apex must be at least 24 inches above the highest sprinkler or other type of water-emitting device. The loop must contain either a vacuum relief or combination air and vacuum relief valve at the apex of the pipe loop. The pesticide injection port must be located downstream of the apex of the pipe loop and at least 6 inches below the bottom of the pipe at the loop apex.

Alternative Device 2 – Pumping over the hill

The pipe laid in the crest of the hill is downstream of the irrigation water pump. At the crest of the hill, the pipe must contain either a vacuum relief valve or combination air and vacuum relief valve. The bottom of the pipe in the crest of the hill must be at least 24 inches above the highest sprinkler or other type of emitting device, and the chemical injection port shall be located downstream of the crest of the hill and at least 6 inches below the bottom side of the pipe at the crest of the hill.

Alternative Device 3 – Pumping down the hill

The field is downstream of the irrigation water source. A vacuum relief valve or combination air and vacuum relief valve is upstream of the injection of the chemical. The inlet pipe must be at least 24 inches above the highest sprinkler or other type of emitting device and the chemical injection port shall be located downstream of the inlet pipe and at least 6 inches below the bottom side of the inlet pipe.

Alternative Device 4 – Artesian Well

A free-flowing artesian well with a shut-off pressure greater than zero. A pressure gauge is placed at the wellhead.

Alternative Device 5 – Injection at the Pivot Point

The volume of the mail line is greater than the volume of the lateral and riser of the pivot. The mail line is sloped downhill with the base of the pivot riser at least 24 inches below the bottom of the inlet pipe. Injection is done at the pivot riser. A vacuum relief or combination air and vacuum relief valve is upstream of the injection of the chemical.

Original Device

Positive displacement pesticide injection pump.

Alternative Device 1

Venturi systems, including those inserted directly into the main water line, those installed in a bypass system, and those bypass systems boosted with an auxiliary water pump. Booster or auxiliary water pumps must be connected with the system interlock so that they are automatically shut off when the main line irrigation pump stops, or in cases where there is no main line irrigation pump, when the water pressure decreases to the point where pesticide distribution is adversely affected. Venturi systems must be constructed of pesticide-resistant materials. The line from the pesticide supply tank to the venturi must contain a functional, automatic, quick-closing check valve to prevent the flow of liquid back toward the pesticide supply tank. This valve must be located immediately adjacent to the venturi pesticide inlet. This same supply line must also contain ***either*** a functional, normally closed, solenoid-operated valve connected to the system interlock ***or*** a functional, normally closed, hydraulically operated valve that opens when the main water line is adequately pressurized. In bypass systems, as an option to placing both valves in the line from the pesticide supply tank, the check valve may be installed in the bypass immediately upstream of the venturi water inlet ***and*** either the normally closed solenoid or hydraulically operated valve may be installed downstream of the venturi water outlet.

Original Device

Vacuum relief valve.

Alternative Device 1

Combination air and vacuum relief valve.

Backflow-prevention Devices

The EPALIP specifies a combination backflow-prevention assembly. This combined assembly consists of an irrigation pipeline check valve, an air/vacuum relief valve, an inspection port, and a low-pressure drain.

The combined assembly is required to:

- Prevent water from flowing back into the water source,
- Drain minor leakage past the check valve, and away from the water source
- Break siphoning action, and
- Allow easy inspection for proper operation of the check valve.

The **irrigation pipeline check valve** prevents chemicals from going into the well if the irrigation pump inadvertently stops. The **air/vacuum relief valve** prevents a vacuum from being formed that could draw chemicals through the check valve. The check valve must have positive closing action (spring-loaded) and a watertight seal. It should be easy to repair and maintain. It should not have metal-to-metal seals. Installation fittings should allow for easy removal for maintenance and repair.

The **inspection port** should be located between the mainline check valve and the pump discharge; it should be at least 4 inches in diameter. This will enable visual inspection of the check valve. The check valve should be inspected at least once a year.

Small amounts of chemicals that may leak by the check valve are disposed of through the **low-pressure drain**. The automatic low-pressure drain should be located on the bottom side of the pipeline directly under the inspection port. Some type of cup or dam must be incorporated into the drain valve to intercept minor leakage from the check valve. The flow of the discharge from the drain must be directed a minimum of 20 feet away from the well or water source. This distance may need to be increased, especially in sandy or gravelly soils. It may be possible to incorporate a container to catch the fluid that drains out the low-pressure drain.

If a centrifugal pump is used in the irrigation system

and it must be kept primed for automatic operation, a second check valve must be used upstream from the backflow-prevention assembly.

Existing irrigation backflow valves may not be suitable for chemigation, especially if the irrigation system pumps water at high pressure. This means the valve is probably a slow-closing type designed to protect pumps and pipelines from pressure surges. If the irrigation system has an especially large pumping installation, smaller chemigation valves placed near fields being chemigated will be better than a single backflow valve.

Interlocks

The power supply of the injection and irrigation pumps must be interlocked. When properly interlocked, the low-pressure cut-off will stop the injection pump should the irrigation pump's power fail. Example interlocks for internal combustion engines (figure 1) and electric motors (figure 2) are shown.

When using an internal combustion engine, the chemical injection device can be powered by belting to the drive shaft or an accessory pulley of the engine (figure 1). The injection equipment can also be operated off the engine electrical system (12 VDC) or off the power source of the sprinkler system drive. ***However it is connected, it is imperative that if the irrigation water supply stops, the chemical injection also stops.***

Some agricultural chemicals may be flammable. In such cases, explosion-proof electric motors and wiring must be used, a separation distance maintained, or the chemical diluted. Wiring must conform to all requirements specified in the National Electrical Code for hazardous area applications. Check chemical labels for specific requirements.

Chemical Injection Line Check Valve

An anti-backflow chemical injection line check valve prevents water from flowing backward into the chemical tank should the injection pump fail. The 10 PSI spring prevents gravity flow of the chemical into the irrigation pipeline when both the injection pump and irrigation pump are shut down. It should be constructed of chemically resistant materials.

Chemical Suction Line Valve

The normally closed solenoid valves, or other alternatives, further ensure that no water will flow into the chemical tank and that no chemical will leave the tank unless it is pumped. This valve provides positive shutoff on the chemical injection line. Power interlocks ensure that all other power will be shut down should any equipment fail, including the center pivot.

Extra Protection

The following safety items are not required, but they afford extra protection when operating a chemigation system:

1. A chemical suction line strainer prevents clogging or fouling of the injection pump, check valve, or other equipment.
2. Installing a valve upstream of the backflow-prevention assembly provides a clean water source.
3. A clear calibration tube installed on the outlet side of the injection device allows for checking injection rates.

Supply Tank

The tank should be constructed of noncorrosive materials such as stainless steel, fiberglass, nylon, or polyethylene. Agitation in the chemical tank is required when wettable powders, dry flowables, flowables, tank mixes, or any other suspended formulations are used. Hydraulic agitation may be sufficient for some soluble chemicals, while mechanical agitation may be necessary for other types of chemicals. Refer to labels for specific instructions. The tanks should be totally self-emptying, such as those with conical bottoms on the tanks.

Hoses, Clamps, and Fittings

Any hoses, gaskets, seals, or other fittings that come in contact with the chemical, from the strainer to the point of injection on the irrigation pipeline, should be made of chemically resistant materials such as polyethylene, polypropylene, EPDM, EVA, Teflon, Hypalon, or Viton. They should also be designed to handle the pressure generated by the chemical injection device. They should also be inspected regularly and replaced at the first sign of wear or deterioration.

Types of Pumps Available

Injection Pumps

The chemical injection pump is the heart of any chemigation system. Within the minimum to maximum pump operating range, a delivery accuracy of plus or minus 1 percent is desirable. The pump should be easily adjusted for different injection rates and mechanically rugged with internal and external components made of acceptable noncorrosive materials. A variety of injection pumps is available, but the type types normally used on center pivot systems are diaphragm and piston pumps. A venturi unit can be used but is not recommended.

The injection pump capacity should be consistent with application rates of the chemicals that will be applied by chemigation. Chemical application rates can range from 1 pint/acre for some insecticides to more than 30 gallons/acre for liquid fertilizer solutions. Consequently, pump injection rates may need to range from as low as 2 gallons/hour to more than 400 gallons/hour. No single pump can do all jobs. Most pumps are graduated in units or percentages that represent the amount of liquid pumped at a particular setting. However, these settings may be less than exact.

Avoid operating a pump at its maximum output or near its minimum output. Such usage can damage the pump and/or result in inaccurate pumping rates. Piston pumps in particular lose suction capabilities proportionally as stroke length of the piston is reduced for pumping smaller amounts. It is most efficient and consistent to operate within the broad middle capacity of each pump.

Diaphragm pumps

Diaphragm pumps have been used in the chemical industry for many years but have only been actively marketed for chemigation during the last few years. Although most diaphragm pumps are more expensive than piston or venturi units, they have several distinct advantages over other injection units:

- They have a small number of moving components.
- A very limited area of the components is exposed to the chemical being injected. This greatly reduces the potential for corrosion, wear, and leakage compared to piston pumps. Consequently, this greatly reduces potential maintenance costs and the potential for the human and environmental safety risks caused by leaks.
- The design of diaphragm pumps makes it easy to adjust the injection rate while the pump is operating. For most of these pumps, the injection rate is changed by simply turning a micrometer-type adjustment knob.

In general, diaphragm types are the best all-around pumps to use for injecting chemicals through irrigation systems.

Piston pumps

The earliest available and actively marketed injection equipment for agricultural chemicals was piston pumps. Both single and dual piston units are available in a wide range of capacities. Their main advantage is that they can inject at a constant rate against fluctuating pressure in an irrigation system. However, these types of pumps commonly have two important disadvantages for chemigation:

- Piston pumps are subject to accelerated wear of piston seals. Related to this is the potential for increased human and environmental safety risks from resultant leakage and increased maintenance costs.
- Calibration of most piston pumps is relatively time-consuming. Altering the injection rate requires that the pump be stopped and the stroke length adjusted mechanically. The pump must then be restarted and the injection rate checked. Several repetitions of this cycle normally are needed to accurately calibrate a piston pump. Some newer piston type pumps can be adjusted while operating.

Piston pumps are most commonly used to apply fertilizers where relatively high injection rates are needed.

Venturi units

Venturi chemical injection units or "pumps" operate by generating a differential pressure or vacuum across a venturi device. This draws the chemical into the irrigation system. ***They are generally not recommended for use on moving irrigation systems.***

The differential pressure is controlled by either:

- A pressure-reducing valve installed in the main line of the irrigation system in parallel with the venturi injection device, or
- A small auxiliary pump (i.e., centrifugal) installed in series with the venturi device with both the auxiliary pump and the venturi device connected in parallel with the irrigation system mainline.

The primary advantage of venturi injection units is their relatively low costs. A major disadvantage of venturi units is the dependence of chemical injection rate upon the available differential pressure. For venturi to be EPA-approved alternative to positive displacement pumps, some additional fittings are required:

1. The line from the pesticide supply tank to the venturi must contain an automatic, quick-closing check valve to prevent the flow of liquid back toward the pesticide supply tank.
2. The valve must be located next to the venturi pesticide inlet.
3. The main supply line must also contain either a normally closed, solenoid-operated valve connected to the system interlock or an approved alternative device.
4. In bypass systems, an alternative to placing both valves in the line from the pesticide supply tank is to place a check valve in the bypass line immediately upstream of the venturi water inlet and either a normally closed solenoid or hydraulically operated valve immediately downstream of the venturi water outlet.
5. Booster or auxiliary water pumps must be constructed of materials resistant to pesticides.

Because the rate of chemical injection is directly dependent upon the differential pressure, any variation in the differential pressure from the calibrated pressure will significantly alter the rate of chemical injection. Variation in flow rate can cause the pressure to vary. Thus, obtaining accurate and consistent rates of chemical injection with a venturi device may be difficult.

Calibration Procedures

Equipment calibration is extremely important in chemigation. Until you calibrate, it is impossible to determine the amount of chemical being applied. Apply too little, and you may not achieve the desired results; apply too much, and you waste money and potentially damage the crop and environment. The objective is to apply the desired amount of chemical (equal to or less than the amount specified on the product label).

Calibrating chemigation equipment is relatively simple, but requires time, equipment, and accurate calculations. ***Always calibrate the irritation system and injection pump yourself rather than relying on data furnished by the manufacturer.*** The manufacturer's suggestions can eliminate the need for much trial and error, but you still needed to determine the exact irrigation water output and injection pump setting. This is because conditions at your work site will not be the same as at the factory.

Measuring Equipment

Measuring equipment includes: a stop watch, a steel measuring tape (preferably at least 100 feet), a pocket calculator, and marking or plot flags large enough to be seen easily at a distance.

Calibration Equipment

Calibration tube

A calibration tube should be located in the line between the supply tank and the chemical injection pump. It is used to measure output of the injection unit during the calibration process. It should be clear, resistant to breakage, and graduated in units of volume (pints, ounces, milliliters, etc.). Calibration tubes must be large enough to hold enough chemical to be injected over a period of five minutes the time it takes to calibrate.

Although not nearly as accurate as a calibration tube, a pressure relief/regulating valve also can be used for calibration. This valve can be used for "rough" calibrations of pump output by installing it on the end of the injection/meeting pump output hose, setting the pressure equal to the irrigation line pressure at the point of injection, and directing the output volume into a measuring can for a specific time period. This method is superior to open discharge pumping into a catch basin because pressure is maintained against the pump.

Calibration involves five basic steps:

1. Determine the area in acres to be irrigated
2. Determine the amount of materials desired per acre
3. Determine the total amount of material required (step 1 x step 2)
4. Determine the time (in hours) that injection will take
5. Determine the injection rate in gallons per hour (step 3/step 4)

Calibrating the center pivot irrigation/chemigation system

The calibration process is based on the given measurement of the irrigation system (length, end gun wetting area, etc.), some common mathematical constants and conversions, and the desired rate of chemical injection. The following calculation must be made: A) area irrigated, B) amount of chemical required, C) travel speed, D) revolution time, and E) chemical application rate. The following example will illustrate the procedure.

A. Area irrigated: The area irrigated must be calculated with one of several possible formulas. The degree of difficulty in making this calculation depends on the configuration of the field. The simplest case would be a complete circle without intermittent end guns or corner water systems. The calculation is:

$$\textbf{Area of the circle in acres} = \frac{\text{pi x r2}}{\text{43,560 sq. ft. per acre}}$$

Where r = the wetted radius (length of pivot plus effective throw of end gun) and pi = 3.1416.

Example:

Assume

R = 1,300 ft.:

$$\text{Area} = \frac{3.1416 \times (1{,}300 \times 1{,}300)}{43{,}560} = 122 \text{ acres}$$

The area irrigated becomes increasingly more complex with partial circles, circles with intermittent end guns, and other configurations. In many situations, it may be wise to leave the end gun turned off because the water pattern is easily distorted by wind. If an end gun shutoff fails, it may result in an off-target application.

B. **Amount of chemical required:**

Chemical required = Acres irrigated x chemical application rate

Example:

Assume 1 qt. chemical is required/acre:

122 acres x 1 qt chemical/acre = 122 qts. (30.5 gallons)

Needed to treat the entire field.

3. Travel speed:

For moving systems, travel speed is one of the most important measurements. When calculating the irrigation system speed, the system should be running "wet" and at the speed and pressure that will be used while chemigating. Always recalibrate when changing speed settings. Avoid determining pivot speed at one percentage setting and mathematically calculating the pivot speeds for other settings, other than to obtain a "rough" figure. Using a stop watch, the proportion of one minute that the end tower is actually moving can be checked against the percentage timer in the pivot control panel.

Two measurements, time and distance, are required to calculate the rotational speed of the pivot. They can be taken in two ways:

1. Record the time necessary for the outer pivot tower to travel a premeasured distance (usually a minimum of 50 feet).
2. Measure the distance traveled by the outer pivot tower in a preselected time (usually a minimum of 10 minutes.

The end result of either method is rotational speed in feet/minute. Be aware that a measurement error of only a few feet or a few minutes can create a significant error in the entire calibration process. If the percentage timer is set at less than 100 percent when determining pivot speed, make sure the start and stop measurements are taken at the same point in the move/stop cycle. (This is not a concern with some oil hydraulic pivots where the end tower moves continuously.) If the terrain is rolling, check rotational speed at several locations in the field and calculate the average value. It may also be wise to verify rotational speed several times throughout the season to account for differences in wheel track resistances due to cover, soil compaction, track depth, etc.

Example

Assume the measured distance per 10 minutes = 65 ft.:

Travel speed = $\frac{65 \text{ ft}}{10 \text{ min}}$ = 6.5 ft/min

D) Revolution time:

Circumference of the last wheel track and rotational speed of pivot are the two measurements needed to calculate revolution time. Circumference is calculated by the formula:

Circumference – 2 x pi x r

Where r = the distance in feet from the pivot point to outer wheel track and where pi = 3.1416.

Example:

Assume r = 1,300 ft.

Circumference = 2 x 3.1416 x 1,300 = 8168 ft.

Even though the owner's manual accompanying the irrigation system might list the system length, the length required for this calculation is from the pivot point to last wheel track (it does not include the overhang). It is a good idea to correctly measure this distance once and permanently record it in the control panel.

Revolution time is calculated by dividing the circumference in feet by rate of travel in feet per minute.

Revolution time = $\frac{\text{Circumference (feet)}}{\text{Travel speed (Ft/min)}}$

Revolution time = 8,167 ft/6.5 ft/min = 1,257 min. per rev.

To convert the revolution time to hours divides the above answer by 60.

Example:

$\frac{1{,}257 \text{ min}}{60 \text{ min/hr}}$ = 21 hours per revolution

E) Chemical application rate:

The application rate is the amount of formulated material needed to treat the field (step b) divided by the revolution time in hours (step D).

Chemical application rate [gallons per hour (gph)] = total material needed (gallons) hrs/revolution

Example

Chemical application rate = $\frac{30.5 \text{ gal}}{21 \text{ hrs}}$ = 1.45

Determining these amounts in gallons per hour (gph) is necessary because most commercially available pumps are rated in gph. Knowing the injection pump capacity in relation to the delivery rate needed can help you establish an initial pump setting. However, be aware that book output values of pumps are normally measured at the factory based on a drive shaft speed of 1,725 revolutions per minute (rpm). Any variance in this shaft speed will alter the pump output. When the injection pump is belt-driven from the engine drive shaft, a tachometer is helpful.

Pump wear will also alter output. Fine tuning should be accomplished using a calibration tube placed on the suction side of the injection pump. Chemicals vary in viscosity and density. Always make the final calibration with the material to be injected and at the operational pressure of the irrigation system. If the volume is small, as with an insecticide, and the calibration tube is measured in milliliters or ounces, gph can be converted to milliliters per minute by multiplying gph by 63.07 or can be converted to ounces per minute by multiplying gph by 2.133.

1. If calibration tube is in milliliters, 1.45 gph x 63.07 = 91.4 ml/minute.
2. If calibration tube is in ounces, 1.45 gph x 2.133 = 3.1 oz/minute

This amount of chemical, in milliliters per minute or ounces per minute, is the working factor to calibrate the injection pump. Using the calibration tube, make coarse adjustments on one-minute time checks. Make a final check over an extended time period (at least five minutes). For an initial injection pump setting, the desired injection rate is divided by to pump capacity to give a percent setting.

Example

Required injection rate is 1.45 gph and pump is rated at 4 gph max.

Injection rate, % of capacity = $\frac{1.45 \text{ gph}}{4.00 \text{ gph}} \times 100 = 36.2\%$

Thus 36 percent is the suggested first setting for the initial calibration attempt.

For Further Information

1. UWCES Bulletin B-1024 *Chemigation Practices for Wyoming*
2. Local Weed and Pest District
3. Local university extension offices
4. Wyoming Department of Environmental Quality/Water Quality Division
5. Local conservation districts
6. Natural Resources Conservation Service
7. *Wyoming Chemigation Manual for Private and Commercial Pesticide Applicator Certification,* UWCES, Department of Plant, Soil, and Insect Sciences
8. Environmental Protection Agency (EPA) Region 8 Office, Denver, Colorado 1-800-227-8917

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Chemigation Practices for Wyoming

Joe Hiller, *Former Assistant Director, Agriculture and Natural Resources*

Mark Ferrell, *Former Extension Pesticide Coordinator*

Andrea M. Lewis, *Former Extension Publication Assistant*

University of Wyoming Extension

Department of Plant Sciences
College of Agriculture and Natural Resources

This bulletin is one of two covering the subject of chemigation. Companion bulletin B-1023 covers chemigation equipment and calibration procedures. It should be noted the following management practices are not official Wyoming Best Management Practices (BMP). These have yet to be developed and approved by the Wyoming Department of Environmental Quality's (WDEQ) Nonpoint Source Task Force (NPSTF).

Irrigation systems today are being used not only to apply water to crops, but also fertilizers, insecticides, herbicides, fungicides, nematicides, and plant growth regulators (PGR). The process of applying chemicals to crops through irrigation water has been termed chemigation.

The purpose of this bulletin is to provide information needed to chemigate safely and effectively. Its intent is to supplement operator's manuals for irrigation and chemical injection systems. This bulletin will focus on procedures for center-pivot sprinkle systems. Center-pivot sprinkler systems and self-propelled linear systems lend themselves well to chemigation. When correctly designed, calibrated, and operated, they allow for a high level of uniformity and precision in the application of water and chemicals to crops.

Regulatory Concerns

State Law and Regulations

Wyoming currently has no laws governing application of chemicals through irrigation water. However, groundwater wells used for chemigation may need to be permitted in the near future under the Wyoming Environmental Quality Act. Be certain you are in full compliance with all applicable rules and regulations by checking periodically with the WDEQ, which monitors the use of agricultural chemicals, the Wyoming Department of Agriculture (WDA), and your local county extension office.
In accordance with paragraph 35-11-301 of the Wyoming Environmental Quality Act:

No person, **except when authorized by a WDEQ permit** issued pursuant to the provisions of [this] act, shall:

i. Cause, threaten, or allow the discharge of any pollution into the waters of the state;
ii. Alter the physical, chemical, radiological, biological, or bacteriological, properties of any waters of the state;
iii. Construct, install, modify, or operate any… system or… facility capable of causing or contributing to pollution.

At this time, WDEQ does not have a formal rule developed to issue a permit for the construction and operation of chemigation wells. WDEQ anticipates development of a chemigation permitting rule in mid- to late-1995. The intent of this rule will

be to prevent pollution of groundwater and surface water by ensuring that all *new* chemigation wells are designed, constructed, and operated according to minimum standards and specifications.

As a minimum, all of the anti-pollution devices identified in companion bulletin B-1023 will be required because U.S. Environmental Protection Agency (EPA) regulations will always be minimum design standards. Wyoming may require more controls and devices. It is likely that an operation and maintenance manual, describing a plan and schedule to inspect and maintain these devices to ensure proper operation, will also be required for a permit.

Until WDEQ/WQD develops its own regulations, producers in Wyoming must follow all rules and regulations of the EPA. Under the EPA Label Improvement Program (LIP), certain chemigation safety equipment is required. Some alternative equipment has been approved for use by the EPA. Refer to bulletin B-1023 for a complete listing of the necessary equipment. A brief summary of federal laws follows.

Federal Laws and Regulations

Federal Insecticides, Fungicide, and Rodenticide Act

All pesticide applications, including those made through an irrigation system, are subject to provisions of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) as amended. FIFRA provisions that will affect an applicator include requirements to:

1. Use pesticides only as directed by the label.
2. Be a certified pesticide applicator or be supervised by a certified applicator if you plan to purchase or use any pesticide classified "For Restricted Use Only."

Pesticide Labels

The label of a pesticide (the document affixed to the pesticide container along with any supplemental labeling that may be provided) constitutes a legal document. It has the same force as federal law. Using any pesticide in a manner inconsistent with its labeling is a violation of FIFRA and can result in legal actions against you. Before buying or using any pesticide, it is important that you first read completely and fully understand the product label.

A pesticide not intended for chemigation will have the following statement on the label: "Do not apply this product through any type of irrigation system."

Under the same law, if a pesticide is allowed to be applied via chemigation, all of the following statement will appear on the product label:

1. "Apply this product only through [a specific type (or types) of irrigation system]. Do not apply this product through any other type of irrigation system."
2. "Crop injury, lack of effectiveness, or illegal pesticide residues in the crop can result from non-uniform distribution of treated water."
3. "If you have questions about calibration, contact state extension service specialists, equipment manufacturers, or other experts."
4. "Do not connect an irrigation system (including greenhouse systems) used for pesticide application to a public water system unless the pesticide label-prescribed safety devices for public water systems are in place."
5. A person knowledgeable of the chemigation system and responsible for its operation, or under the supervision of the responsible person, shall shut the system down and make necessary adjustments should the need arise."

FIFRA Exemptions

In general, a producer may apply a pesticide by any method not specifically forbidden by the label. The site (crop) on which you wish to apply a pesticide must appear on the label. It is violation of FIFRA to use a pesticide if the crop is not listed on the label. A pesticide may be applied against any pest occurring on any crop, animal, or site specified on the label unless use of the pesticide is limited only to those pests specified on the labeling.

Applying more pesticide than the label specifies also violates FIFRA. To be certain you are using the proper rate, it will be necessary to calibrate your chemigation system. Procedures for doing this are described in bulletin B-1023. It is permissible to apply a pesticide at any dosage, concentration, or frequency ***less*** than that specified on the labeling.

Federal Water Pollution Control Act

Amendments to the federal Water Pollution Control Act generally provide to the federal government authority only over surface waters. If surface waters (streams, rivers, lakes, etc.) are used as an irrigation water source, any pollutant discharge (such as pesticides or fertilizers) incident to chemigation operations may subject the violator to federal prosecution. In most states, regulation of pollutant discharges into ground water is provided through state programs approved under the Water Pollution Control Act.

Federal Safe Drinking Water Act

There may be cases in which the irrigation well is situated in close proximity to the municipal water well. Any backflow of water and/or chemical that enters an aquifer that is or could be used as a public drinking water source is a violation of the Federal Safe Drinking Water Act. Laws in some states may prohibit chemical injections into irrigation systems if the irrigation water is drawn from a well within a given distance of a public drinking water source. If your irrigation system is connected to a public drinking water source, special equipment may be required such as a reduced-pressure principle backflow prevention assembly.

Resource Conservation and Recovery Act

Disposal of pesticides or pesticide-contaminated materials such as containers and rinsate is subject, under some conditions, to the requirements of the Resource Conservation and Recovery Act. Be sure to follow label directions carefully when disposing of such materials.

Advantages of Chemigation

Uniformity of application – With a properly designed sprinkler irrigation system, water and chemicals can be uniformly applied, resulting in excellent distribution of the water-chemical mixture.

Precision application – Chemicals can be applied where they are needed and in the correct concentrations.

Incorporation and activation – Materials requiring incorporation and water for activation can be applied to the desired depth and activated immediately.

Economics – Applying chemicals through chemigation is often less expensive than conventional application methods. Also, the amount of chemicals needed can be reduced. The more chemical treatment an operator applies, the more cost-effective chemigation becomes.

Timeliness – Chemicals can still be applied when other methods cannot be used due to wetness, excessive wind, applicator availability, or other factors.

Reduced soil compaction and crop damage—Conventional in-field spray equipment is not needed, often resulting in less crop damage and less soil compaction from tractor wheels.

Operator safety – Because the operator is not continuously in the field during application, there is reduced human contact with the chemicals from drift, frequent tank fillings, and other exposures.
Nitrogen fertilizer application - Chemigation allows for more frequent and lighter applications of fertilizers. Using proper water management practices, chemigating nitrogen fertilizer reduces the potential for nitrate leaching into the groundwater. Considerable leaching will occur, however, if correct timing or irrigation amounts are not used.

Effectiveness – The effectiveness of fertilizers, herbicides, insecticides, fungicides, nematicides, and PGRs when applied through chemigation has been proven over several years of research.

Disadvantages of Chemigation

Potential for ground water and surface water pollution – Ground water pollution can occur in one of two ways. Water can backflow through the chemical injection system and cause an overflow from the chemical supply tank. Or a power failure can occur, which would allow the chemical solution to flow backward and pollute the well. Both can be avoided if proper equipment is incorporated into the pumping plant.

Additional pollution problems – Chemical-laden water could drift or run onto non-targeted areas or be inadvertently applied to open surface water in a field.

High management – Chemical application always requires the safe use of chemicals, skill in calibration, knowledge of the irrigation and chemigation equip-

ment, and an understanding of irrigation scheduling concepts.

Additional equipment—Proper injection and safety devices are essential. Legal equipment requirements have been established and must be used. Refer to bulletin B-1023 for a complete discussion of equipment requirements.

The most significant risk is potential contamination of the irrigation water supply. To minimize risks related to chemigation, an irrigation system must be properly equipped and operated. Antipollution equipment must be added to the system and procedures must be followed to ensure operator and environmental safety as well as desired results of the chemical application. Refer to bulletin B-1023.

Deciding to Chemigate

Because extra equipment is needed to chemigate, time should be taken to consider all the possibilities before investing. Is irrigation necessary for production? Is there already a center pivot system being used to irrigate? How often do you/would you chemigate each year? Is there a crop being grown that would benefit from chemical application of one type or another? Is the chemical that is normally used or intended for use able to be applied via chemigation? Several additional factors also should be considered:

Cost-effectiveness

If application is made only once a year, chemigation may only be cost-effective for chemicals that require incorporation. But as application rates increase to two or more times per year, chemigation becomes more cost-effective.

Irrigation System Location

Proximity of an irrigation system in relation to occupied buildings or dwellings, surface water sources, neighboring crops and roadways must be carefully considered. Person, wild and domestic animal life, and other non-target sites must not be endangered.

Soil Type

Soils can differ considerably over relatively short distances. Therefore, it is not uncommon to find different types of soils within a single field. The rate at which water and/or agricultural chemical(s) enter the soil (infiltration rate) differs according to soil type. It follows that variations in soil type will influence irrigation system management and chemigation operations. Consult soil survey maps published by Natural Resources Conservation Service (NRCS) (formally the Soil Conservation Service) for specific soil characteristics. NRCS and extension personnel can help with irrigation management.

Topography

Topography of the field can substantially affect uniformity of application through an irrigation system lacking properly regulated sprinklers. Variations in terrain along the length of the irrigation system will cause differences in pressure at various nozzle outlets. This results in uneven water distribution, especially with low-pressure systems. Uneven water distribution can be corrected by using pressure regulators on each individual sprinkler. If distribution variances are not corrected, your irrigation system may be unsuitable for chemigating.

Management Practices

Management practices should be employed to maintain the existing beneficial uses of water resources and to reduce adverse effects and water quality degradation.

Center Pivot Systems

Center pivots have a high instantaneous rate of water application. If the infiltration rate of the soil is exceeded, runoff of chemical-water solution may occur. Therefore, the center pivot sprinkler package should be selected to minimize runoff potential. Work with the irrigation system deal, extension or NRCS, and/or your local conservation district to select a sprinkler package to match the field being irrigated. In many situations, the quantity of irrigation water applied will be small enough that runoff will not be a major concern.

The amount of water applied by a center pivot during one irrigation cycle is determined by the irrigation pumping rate and the revolution time of the center pivot system. The minimum irrigation amount will be

applied when the system is operated at the maximum rotation speed. Consult your system operator's manual for specific system information.

Equipment Maintenance and Inspection

All irrigation and injection equipment must be kept in good working order. In addition, instructions on chemical labels must be followed precisely. Most chemical accidents result from careless practices or lack of knowledge about safe handling of chemicals. Time spent taking precautionary safety measures is an investment in the health and safety of yourself, your family, and others, and in protecting the environment. It also helps assure that the desired results are achieved.

Proper equipment maintenance is necessary to ensure safe distribution of chemicals. Consequently, all hoses, clamps, and fittings must be in good repair. Inspect them before each chemigation operation. All components that are in contact with chemical, from the supply tank to the point of injection on the irrigation pipeline, should be constructed of chemically resistant materials.

Periodically monitor the irrigation system and chemical injection equipment to assure proper operation. Before chemigating, inspect your equipment to be certain the following items are functioning properly:

- The irrigation system main pipeline check valve and vacuum relief valve
- The chemical injection line check valve
- The irrigation system and pumping plant main control panel and the chemical injection pump safety interlock
- The low pressure drain
- The injection system including the in-line strainer
- The irrigation pump and power source
- Casings, manifolds, and pipelines are not leaking

Read and comply with product label

If you plan to apply a pesticide, always read the product label before starting to chemigate and comply with all directions given. Be certain that:

- The product is labeled for application by chemigation
- The crop on which you plan to apply the pesticide is listed on the label
- The rate at which the product is applied does not exceed the quantity or frequency specified
- All items of safety clothing and equipment specified are used
- Empty pesticide containers are triple rinsed and disposed of as directed

Drive units

High-speed center pivot drive units are desirable with some chemicals so that lighter applications of water can be made.

Chemical compatibility

Check compatibility of the chemical with the water supply. Avoid chemicals that may form a precipitate that could clog nozzles on the system.

Monitoring

During any chemical application, periodically monitor the irrigation system and chemical injection equipment to be certain both are operating properly.

Plug first nozzle on center pivots

To facilitate monitoring of the chemigation operation, the main control panel, water pump, chemical supply tank, chemical injection pump, and the area around them must be kept free of chemical contamination. Plugging the nozzle outlets in the immediate area of this equipment will significantly reduce the possibility of inadvertent exposure to chemical contamination.

Wind speed

Wind distorts the irrigation application pattern, causing non-uniform distribution. Disruption of the sprinkler irrigation pattern is least with continually moving systems and greatest with solid-set systems. Wind increases evaporation and can increase the loss of volatile chemicals. Pesticides and PGRs should not be applied in sprinkler irrigation systems if wind speed exceeds 10 miles per hour for continually moving systems and 7 miles per hour for solid-set systems.

Calibration

Accurate calibration of the application system is critical. Unless the system is calibrated, there is no way to determine whether the amount of chemical applied is too much, too little or – by chance – just right. Over-application is needlessly expensive. Under-application frequently does not provide the effect needed. Refer to bulletin B-1023 for calibration procedures.

Accidental spills

Pesticide spills must be managed according to WDEQ/WQD Chapter IV, Section 4, rules and regulations. Regardless of the size of a chemical spill, take steps to avoid personal contamination and to keep the potential spill damage to a minimum. Do not let children or other people near the spill area. Do not let the chemical (especially pesticides) get on your skin, clothing, or shoes.

Confine the spill if possible. If it starts to spread, dike it with soil or sand. Avoid letting the chemical flow away from the spill site into any surface water source. Special precautions, such as removing the contaminated soil, may be necessary to prevent ground water contamination.

Regulatory officials need to be notified in the event of a spill. If water contamination is suspected, notify state health and water quality officials. Information such as the type, quantity, and location of the spill, and the response, containment, and cleanup actions that will be/have been taken is required. These officials may have suggestions and/or requirements for cleaning up a spill.

Non-target application

An end gun shutoff that fails to function and unfavorable weather conditions are likely sources of non-target and off-target applications. End gun operations must be monitored to be certain they do not operate over roadways or across fence lines.

Spray from continuous moving irrigation systems can be carried considerable distance by wind. Drift can result in violations of the law for misapplication of a pesticide and illegal pesticide residues in or on a crop. Drift can also damage your own non-target crops or a neighbor's.

Wind variations can have a detrimental effect on semi-permanent sprinkler systems such as wheel lines, hand lines, and solid set lines. To minimize problems associated with wind drift, these steps can be taken:

- Avoid use when winds are great enough (7-10 miles per hour) to cause significant drift
- Space the sprinklers and lines more closely together if possible
- Operate at night when winds are relatively low

Protective clothing and equipment

Because of the toxicity of many agricultural chemicals, pesticides in particular, they are potentially dangerous to people. Pesticide product labels have "signal" words that clearly indicate the degree of toxicity – and the degree of risk to the user – associated with that product. Pesticides labeled CAUTION are slightly toxic; an ounce to more than a pint, if taken orally, would kill the average human adult. Those labeled WARNING are moderately toxic; a teaspoonful to an ounce would be fatal to the average adult. Pesticides labeled DANGER include the skull and crossbones symbol and are highly toxic; a teaspoonful or less would be fatal.

Application to surface water

Don not use chemigation on fields with permanent or semi-permanent surface water areas. Direct discharge of pesticides into *any* surface water is a violation of WDEQ/WQD regulations. Such application may adversely affect wildlife, non-target plants and animals, or ground water quality.

Runoff/Deep Percolation

The irrigation system should be managed so runoff or deep percolation of the water-chemical mixture does not occur. If runoff does occur, precautions should be taken to prevent runoff from leaving the field when any chemical is being applied. With a given sprinkler package on a center pivot, reducing the application size by making a faster revolution will reduce the potential for runoff and deep percolation. Good irriga-

tion management practices must be used throughout the entire irrigation season to avoid movement of water below the crop root zone and to minimize the potential for chemical leaching.

Flushing injection equipment

To prevent accumulation of precipitates in the injection equipment, flush the injection system with clean water after each use. It is best to flush the injection system while the irrigation system is operating so that the water used for cleaning will be applied to the field where the chemigation application was made.

Flushing irrigation system

After injection is completed, operate the irrigation pump for at least 10 minutes to flush the irrigation system of any chemical. Some systems, especially drip systems, may take longer than 10 minutes to completely flush. If the irrigation system was shut down automatically, flush the system as quickly as possible after the shutdown is discovered, and extend the flushing period to a minimum of 30 minutes.

Reentering treated areas

In general, fields that have been chemigated with pesticide should not be reentered until the spray has dried. A specific waiting period may be specified on the container label of some products. In such cases, applicators have a legal obligation to prevent unauthorized entry into treated areas. To discourage such unauthorized entry, applicators may be required to post treated fields. The EPA may revise its label requirements to include more restrictive provisions on posting chemigated fields. Failure to properly post a chemigated field can result in prosecution of the applicator. Before chemigating, therefore, carefully read the product label and comply with posting requirements that may be specified. Check with the pesticide regulatory authority in your state to be certain you are in compliance with applicable state laws and regulations.

For further information:

1. USCES bulletin B-1023 *Chemigation Equipment and Calibration Procedures*
2. Local weed and pest districts
3. Local university extension offices
4. Wyoming Department of Environmental Quality/Water Quality Division
5. Local conservation districts
6. Natural Resources Conservation Service
7. *Wyoming Chemigation Manual for Private and Commercial Pesticide Applicator Certification*, UWCES, Department of Plant, Soil, and Insect Sciences
8. Environmental Protection Agency (EPA) Region 8 office, 1-800-227-8917

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7 Appendix 1

APPENDIX 1

Example Problems for Pesticide Applicator Exams

1. A commercial applicator has contracted to treat the highway shoulder on an interstate highway system. He has agreed to apply 2 oz. of Oust per acre on an 8-foot wide shoulder on one side of the road for 80 miles. How much Oust must be purchased to complete the job.

    a. 123 oz.
    b. 155 oz.
    c. 446 oz.
    d. 892 oz.

2. You have purchased a new sprayer and do not know its output. If the boom has 22 (8004) nozzles spaced 20 inches apart and you sprayed 12 gallons in a 1,000 foot single pass, how many gallons per acre would the sprayer output be?

    a. 3.5 gallons/acre
    b. 7.1 gallons/acre
    c. 14.2 gallons/acre
    d. 28.4 gallons/acre

3. You are calibrating a sprayer with water by the refill method. After filling the tank to a marked, level you spray an area 10 ft. wide and 435.6 ft. long. After careful measure of the water required to fill the tank to same marked level, you find that a total of 6 gallons were used. How many gallons per acre did you apply?

    a. 2.5 gallons/acre
    b. 25 gallons/acre
    c. 37.5 gallons/acre
    d. 60 gallons/acre

4. A herbicide which is 75% dry flowable would require how many pounds of formulation to apply 2 lb/a active ingredients on 30 acres?

5. Your sprayer applies 20 gallons per acre. Using a herbicide that contains 5 lb/gallon active ingredient, how many quarts of the herbicide should be added to a 300-gallon spray tank if the application rate is 2 pounds **[A.I.]** per acre?

6. If the herbicide is 80% wettable powder, how many pounds would be used if the rate of application is 2.0 pounds active ingredient per acre?

What you need to know and steps to solve the problems

1. *Need to know: 43,560 ft sq per acre. 5,280 linear feet per mile.*
   Calculate total sq. feet:
   Calculate total Acres:
   Calculate oz of Oust:

2. *Need to know: 43,560 ft sq. per acre.*
   Calculate total sprayer width:
   Calculate % of acre covered in one pass:
   Calculate Gallons per acre:

3. *Need to know: 43,560 ft sq. per acre.*
   Calculate area covered:
   Solve for X:

4. *Understand that for every 1 lb of formulated product there is 0.75 lb a.i.*
   Solve for X:
   Answer is:

5. *Need to know: 128 oz per gallon & 32 oz per quart*
   Calculate number of Acres covered by one tank full:
   Calculate oz for 2 lb a.i.:
   Calculate total oz for (n) acres:
   Convert to quarts:
   Convert to Gallons:

6. *Understand that for every 1 lb of formulated product there is 0.80 lb a.i.*
   Calculate amount:
   Answer is:

Answer Key for Example problems

1. *b*
2. *c*
3. *d*
4. *2.66 lbs formulated product*
5. *6 gallons*
6. *2.5 lbs product per acre*

Insecticide Mode of Action Chart & Pest Activity

Mode of Action	IRAC*	Pest Control Materials	Type	Pest Activity (based on label)								
				WF	Aphids	Thrips	MB	SM	FG	SF	LM	CAT
Acetylcholine Esterase Inhibitors	1B	Acephate (Orthene)	**C,S,T**	**X**	**X**	**X**	**X**					
	1B	Dhlorpyrifox (DuraGuard)	**C**		**X**	**X**	**X**		**X**	**X**	**X**	**X**
	1A	Methiocarb (Mesurol)	**C**		**X**	**X**						
Prolong Opening of Sodium Channel	3	Bifenthrin (Talstar/Attain)	**C**	**X**	**X**	**X**	**X**	**X**	**X**			**X**
	3	Cyfluthrin (Decathlon)	**C**	**X**	**X**	**X**	**X**		**X**			**X**
	3	Fenpropathrin (Tame)	**C**	**X**	**X**	**X**	**X**	**X**			**X**	**X**
	3	Fluvalinate (Mavrik)	**C**	**X**	**X**	**X**		**X**				**X**
	3	Lambda-cyhalothrin (Scimitar)	**C**	**X**	**X**	**X**	**X**	**X**			**X**	**X**
Nicotinic Acetylcholine Receptor Disruptors	4A	Acetamiprid (TriStar)	**C,S,T**	**X**	**X**	**X**	**X**		**X**		**X**	**X**
	4A	Dinotefuran (Safari	**C,S,T**	**X**	**X**	**X**	**X**		**X**		**X**	
	4A	Imidacloprid (Marathon)	**C,S,T**	**X**	**X**	**X**	**X**		**X**		**X**	
	4A	Thiamethoxam (Flagship)	**C,S,T**	**X**	**X**		**X**		**X**			
Nicotinic Acetylcholine Receptor Agonist and GABA Chloride Channel Activator	5	Spinosad (Conserve)	**C,T, ST**			**X**		**X**			**X**	**X**
GABA Chloride Channel Activator	6	Abanectunb (Avid)	**C,T**	**X**	**X**	**X**		**X**			**X**	**X**
Juvenile Hormone Mimics	7B	Fenoxycarb (Preclude)	**C**	**X**	**X**	**X**	**X**	**X**			**X**	**X**
	7A	Kinoprene (Enstar II/AQ)	**C**	**X**	**X**	**X**	**X**		**X**			
	7C	Pyriproxyfen (Distance)	**C,T**	**X**	**X**		**X**		**X**	**X**	**X**	
Chitin Synthesis Inhibitors	16	Buprofezin (Talus)	**C**	**X**			**X**					
	17	Cyromazine (Citation)	**C**						**X**	**X**	**X**	
	15	Diblubenzuron (Adept)	**C**	**X**					**X**	**X**	**X**	**X**
	10B	Etoxazole (TetraSan)	**C,T**					**X**				
	15	Novaluron (Pedestal)	**C**	**X**		**X**					**X**	**X**
Growth and Embryogenesis Inhibitors	10A	Clofentezine (Ovation)	**C**					**X**				
	10A	Hexthiazox (Hexgon)	**C**					**X**				
Selective Feeding Blockers	9C	Flonicamid (Aria)	C,S,T	X	X	X	X					
	9B	Pymetrozine (Endeavor)	C,S,T	X	X							
Disruptors of Insect Midgut Membranes	11A1	*Bacillus thuringiensis* var. i*sraelensis* (Gnatrol)	ST						X			
	11B2	*Bacillus thuringiensis* var. *kurstak*	ST									X

		(Dipel)										
Oxidative Phosphorylation Uncoupler	13	Chlorfenapyr (Pylon)	C,T			X		X	X			X
Ecdysone Antagonist	18B	Azadirachtin (Azatin/Omazin/Molt-X/Azatrol)	C	X	X	X	X		X	X	X	X
Mitochondria Electron Transport Inhibitor	20B	Acequinocyl (Shuttle)	C					X				
	25	Bifenazate (Floramite)	C					X				
	21	Fenazaquin (Magus)	C	X				X				
	21	Fenotrixunate] (Akari)	C				X	X				
	21	Pyridaben (Sanmite)	C	X				X				
	21A	Tolfenpyrad (Hachi-Hachi)	C	X	X	X						X
Desiccation or Membrane Disruptors		Neem oil (Triact)	C	X	X		X	X				
		Paraffinic oil (Ultra-Fine Oil)	C	X	X	X	X	X	X	X		X
		Petroleum Oil*	C	X	X	X	X	X	X	X		X
		Potassium salts of fatty acids (M-Pede)	C	X	X	X	X	X				
Lipid Biosynthesis Inhibitor	23	Spiromesifen (Judo)	C,T	X				X				
	23	Spirotetramat (Kontos	C,S,T	X	X		X	X				
Unknown		*Beauveria bassiana* (BotaniGard/Naturalis	C	X	X	X	X					X
		Pyridalyl (Overture)	C,T,ST			X						X

Pest Activity Code	Type Codes
WF=Whiteflies	C=Contact
MB=Mealybugs	S=Systemic
SM=Spider Mites	T=Translaminar
FG=Fungus Gnats	ST=Ingested
SF=Shoreflies	*Insecticide Resistance Action Committee (IRAC) designation, which appears on product label.
LM=Leafminers	**Products=PureSpray Green, Ultra-Pure Oil, SuffOil-X
CAT=Caterpillars	***Products=Insecticidal Soap and M-Pede