

# Agrochemicals and Security

A Training Module for the  
Safe and Secure Storage of  
Pesticides and Fertilizers



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Florida Cooperative Extension Service, 2005

# Agrochemical and Security

## A Training Module for the Safe and Secure Storage of Pesticides and Fertilizers

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The Agrochemical and Security Series is available for download from the Florida Cooperative Extension's Disaster Handbook Web site <<http://disaster.ifas.ufl.edu>>. The series comprises six units:

- Why It Matters (An introduction to agrochemical security)
- Chemical Safety
- Homeland Security and Fertilizers
- Homeland Security and Pesticides
- Security and Anhydrous Ammonia
- Developing a Hazard Mitigation Plan

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## About Florida AgSafe

Florida AgSafe is a program of the Florida Cooperative Extension Service that provides information and educational materials for agricultural safety and for disaster preparedness and recovery. Materials produced by Florida AgSafe are available on the Web at <[www.flagsafe.ufl.edu](http://www.flagsafe.ufl.edu)> and at the Florida Cooperative Extension publication Web site <[edis.ifas.ufl.edu](http://edis.ifas.ufl.edu)>.

### Our Goals

- To inform people about ways to be safe and secure, and thereby reduce the number of deaths, injuries and occupational diseases, particularly for agricultural workers and their families.
  - To build a safety infrastructure for Florida through five activities: training of workers, training of students, publications, networks, and linkages.
  - To encourage adoption of safe practices among employees and clientele. Every employee or client should be exposed to a safety tip or safety practice on a regular basis.
  - To prepare the people of Florida to face disaster of any kind, to mitigate losses, both in life and property, and to promote rapid and effective recovery.
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## **Preface**

For many years, producers have been aware of the health hazards of pesticides. These materials are carefully regulated, and the safety requirements for every pesticide product are spelled out in detail. Most fertilizers have been in an opposite category, considered useful, safe and inert. However, in recent years, agricultural chemicals — specifically, fertilizers — have been used in some of the most damaging terrorist attacks around the world.

These attacks have given the general public, agricultural producers and governmental authorities a new point of view. It is important for all to realize that, in the wrong hands, agricultural chemicals, including fertilizers and pesticides, could be used to do great damage.

This module provides several units which address different aspects of this problem. There are six units in this training module (with the page numbers where they can be found in this manual):

Unit 1: Introduction: Agrochemicals and Security — Why It Matters .....	5
Unit 2: Chemicals and Safety .....	15
Unit 3: Homeland Security and Fertilizers .....	51
Unit 4: Homeland Security and Pesticides .....	85
Unit 5: Security and Anhydrous Ammonia .....	125
Unit 6: Developing a Hazard Mitigation Plan .....	161

Units can be used separately or in combinations depending on audience needs. Each unit consists of:

- A narrative which gives background material;
- A PowerPoint presentation which parallels the narrative;
- Pre- and post-tests, and an evaluation; and
- Table-top exercises (selected units).

The module is structured to give the presenter plenty of flexibility. Use all six units with table-top exercises to create a day-long workshop on agricultural security, or show only one PowerPoint presentation with a question and answer period for a 20- to 30-minute training session. Reduced images of all PowerPoint slides are included with each unit and can be copied to create a participant workbook.

## **How to Use Pre- and Post-Tests**

The idea of a “pre-post” test is that participants take the same brief quiz before and after the presentation. This gives the presenter and the participants an objective view of how much participants learned and how effective different points in the presentation were. A pre-post test takes just a few minutes before and after the presentation, but it can be a valuable tool for evaluating the presentation and reporting its impact on participants.

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## Unit 2: Chemicals and Safety

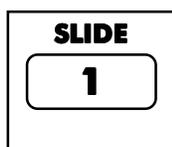
<b>Subject</b>	Workers pack, distribute, handle, mix and apply all sorts of chemicals. In virtually every occupation, they will come into contact with flammable materials, solvents, toxins, or any of many other categories of chemicals.
<b>Goal</b>	Make workers aware of the different kinds of chemicals they might come into contact with, characteristics of those chemicals, and potential hazards.
<b>Objectives</b>	As a result of this session, participants will: <ul style="list-style-type: none"><li>• Understand that all chemicals present possible hazards.</li><li>• Understand that safe storage is an important issue.</li><li>• Understand that many chemical injuries result from improper storage.</li><li>• Know their rights and responsibilities when working with chemicals.</li><li>• Know four basic rules of chemical safety.</li><li>• Be aware of the categories of dangerous chemicals and specific safety precautions appropriate to each category.</li></ul>
<b>Session Outline</b>	Part 1: Welcome and Introduction Part 2: Unit Learning Objectives Part 3: Pre-Test Part 4: Module Introduction Part 5: Learning Sections  Section 1: Introduction Section 2: Chemicals: Helpful and Harmful Section 3: Basic Rules of Chemical Safety Section 4: "Safe" Storage and Causes of Injury Section 5: Right-to-Know and MSDS Section 6: Chemical Categories Section 7: Summary  Part 6: Questions and Discussion Part 7: Post-Test Part 8: Session Evaluation Part 9: Adjourn

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**Learning Environment and Aids**

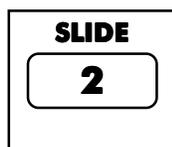
To conduct this training, you will need:

1. "Chemical Safety" PowerPoint presentation, and a means to show it. (Download from the UF/IFAS Disaster Handbook Web site: <<http://disaster.ifas.ufl.edu>>.)
2. Note paper or PowerPoint slide pages to serve as participant workbooks
3. If desired, sufficient copies of the Pre- and Post Test for all participants to take the test both before and after session
4. Unit 2 evaluation forms.

**Part 1 — Welcome and Introduction**

Take a moment at the beginning of the lesson to welcome the participants to the session. Introduce yourself as the presenter, and remind participants of the title and subject (above) of the session.

If participants have not covered the Module Introduction in a previous session, present that material now as a general introduction to the importance of agricultural security.

**Part 2 — Unit Learning Objectives**

Briefly introduce the audience to the learning objectives for this unit:

- Understand that all chemicals present possible hazards.
- Understand that safe storage is an important issue.
- Understand that many chemical injuries result from improper storage.
- Know their rights and responsibilities when working with chemicals.
- Know four basic rules of chemical safety.
- Be aware of the categories of dangerous chemicals and specific safety precautions appropriate to each category.

**Part 3 — Pre-Test**

If you choose to administer pre- and post-tests, do so now before you do anything else. Explain to the participants that everyone will take a short quiz before the session just to give themselves a clearer idea of what they already know about the subject and some things they will learn during the session. Tell them that they will take the same test at the end of the session and this will help the presenter by giving an idea of the effectiveness of the session. The pre- and post-tests should take only a few minutes each.

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## Part 4 — Module Introduction

The Chemical Safety Unit is a stand-alone unit. It can be presented without reference to homeland security issues, so the presenter may choose not to use the Module Introduction if the only unit that will be used for an educational program is this Chemical Safety Unit. However, any program that includes one of the security units should begin with the Module Introduction.

## Part 5 — Learning Sections

### Section 1: Introduction

Before we talk about secure storage of agrochemicals, let's discuss some ideas about the safe storage and handling of dangerous chemicals in general.

SLIDE

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### Section 2: Chemicals: Helpful and Harmful

Having the right tool for the job is well-known wisdom about doing a job effectively and efficiently, and it applies to chemicals the same as tools. Hardware and grocery store shelves are filled with products that dissolve, bleach, clean, remove, enhance... there seems to be a specific chemical for just about every task. Chemicals are everywhere in our lives helping us to do our work and live our lives.

However, most chemicals also pose dangers if used improperly, and it is very important to know correct methods for storage, handling, use and disposal. Chemicals can be dangerous for different reasons. A simple example is soap. Applied to skin, soap is very useful and not painful; applied to the eyes, it is usually painful, but not dangerous; if eaten, soap is dangerous, but not likely to be fatal.

SLIDE

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There are many chemicals we work with every day, and we feel ourselves to be very familiar with their limitations – chemicals such as bleach, or lye, or gasoline. Nevertheless, every year people are injured by these common chemicals when they are unaware of or ignore standard precautions, such as: Never mix bleach with ammonia (it produces a deadly gas); Never mix lye with acids (the mixture can explode causing serious burns); and Never dispense gasoline in the presence of a spark or open flame.

In this unit, we will look at the different categories of dangerous chemicals.

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SLIDE

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For each one, basic properties and safe storage and handling procedures will be listed. Some of the chemicals in these lists are very common, and you may use them frequently. Others are quite rare, but should you encounter them, you might remember hearing about them, and have some forewarning about what you are dealing with.

### Section 3: Basic Rules of Chemical Safety

SLIDE

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Before we discuss any other aspect of handling chemicals, it's a good idea to emphasize four basic rules of chemicals.

#### Rule #1

##### **Don't buy or store chemicals you do not need.**

SLIDE

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Having chemicals that you never use just adds to possible dangers in your work or home environment. Many chemicals degrade over time, so having them around "just in case" can be a poor idea. When you have a job that needs a chemical, purchase what you need for the job. Write the date of purchase on the label so that when you sort through your garage or workspace (as we all do from time to time) and wonder "How long have I had this?" you'll know just by looking at the label.

#### Rule #2

##### **Store chemicals in their original containers.**

SLIDES

8-9

There are two very important reasons for this. First, the chemical was sold in a container designed to hold it for a long period of time. You may not be aware of how an unusual chemical or chemical mixture will affect another kind of container. If the container becomes damaged, the chemical may leak out. If the chemical reacts with the container and changes its chemical composition, you will have an unknown substance in the container which may pose serious risks. Of course, avoid storing chemicals in breakable containers.

Second, the original container will have an accurate label. Keeping chemicals in their original containers means that you will always know what was originally in the container. When operations change and certain chemicals are no longer needed, the label is your best information about what chemicals should be disposed of and when to dispose of them. People can be seriously injured when they try to identify unlabeled chemicals by inappropriate means such as smelling or tasting.

**Rule #3****Always wear appropriate safety gear and work in a safe environment.****SLIDE****10**

Always wear eye protection when handling chemicals. Regardless of their toxicity, powdered chemicals can get in your eyes and cause abrasions and liquid chemicals can splash. Your reflex to protect your eyes can cause mishaps. (Learn more about eye safety at the Florida AgSafe Web Site. Look for the Eye Safety PowerPoint under "Publications.")

Wear appropriate gloves, aprons, masks – whatever you need to prevent inhaling or swallowing chemicals or letting them leach through your skin.

Work in a proper environment for the chemicals you are handling. Ensure proper ventilation. No open flames. No unprotected bystanders.

The Material Safety Data Sheets (MSDS) that come with many chemicals can guide you to the correct safety equipment and environment. Remember: "The label is the law." However, whatever is specified on the label is the minimum requirement for personal protective equipment (PPE).

**Rule #4****Always dispose of chemicals safely.****SLIDE****11**

Most municipalities have made provisions for proper disposal of toxic waste. Often, one phone call to the fire department or to a waste disposal agency will answer your questions about what is the right thing to do with an old can of acetone or bottle of sulfuric acid. Never pour dangerous chemicals "down the drain" or onto the soil. This often creates long-term contamination problems, which are especially dangerous in areas where food is grown or where water is drawn from local wells. Whether it is a pint can or 55-gallon drum, always dispose of chemicals properly. Many communities offer toxic-waste clean-up days or programs.

**Section 4: "Safe" Storage and Causes of Injury****SLIDE****12**

Chemical storage is one of the most important topics to discuss when talking about the use of chemicals. Fire and explosion are probably the most familiar hazards associated with improper storage, but chemicals can pose other dangers. Thousands of incidents resulting from improper storage are reported every year across the United States. A review and analysis of storage-related incidents identified the following principal causes:

SLIDE

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1. Improper or non-existent labeling of chemicals in storage
2. Storage of chemicals beyond the recommended shelf life
3. Degradation of chemical storage containers.

Following the Basic Rules of Chemical Safety will help assure that you, your family or your workers are never injured in these ways.

Chemicals cause injuries in a variety of ways:

SLIDE

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1. Chemical Burns (strong acids, strong bases)
2. Heat Burns (flammable materials)
3. Poisoning (many chemicals are damaging or fatal if taken internally, whether by swallowing, injection, or leaching through skin)
4. Chronic illness (long-term exposure to even low doses of certain chemical agents can lead to chronic health conditions).

SLIDE

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It's very easy to dismiss the danger of working with chemicals when they are a normal part of an operation. Learn good habits for working with chemicals from the beginning and practice these habits every day.

## Section 5: Right-to-Know and MSDS

SLIDE

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The Occupational Safety and Health Administration (OSHA) has created guidelines under which workers have a right to know what chemicals they might be exposed to in their work environment and what the dangers and appropriate precautions are for working with those materials. Many states have adopted these guidelines in the form of "Right-to-Know" laws. Under these laws, both employers and employees have obligations. Employers are required to inform employees (or make information available) about any chemicals they work with. Employees are required to follow established procedures when handling dangerous chemicals.

Which chemicals are covered by Right-to-Know laws? The Federal Register contains a long list of chemicals which are covered by this law. Individual states also have right-to-know laws and lists of hazardous chemicals. For these chemicals, employers must maintain records, including information about their dangers and safety precautions.

SLIDE

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When a listed chemical is purchased, the manufacturer is required to supply information about the chemical, including its name, chemical properties,

dangers, modes of injury, safety precautions, and medical response. These forms are called Material Safety Data Sheets (MSDS), and employers are required to have current MSDS on file for all listed registered chemicals in their facility. Many MSDS are available on the Internet.

## Section 6: Chemical Categories

**SLIDE****18**

For the purposes of this unit, we divide dangerous chemicals into seven categories. Categories 1-6 are based on the chemical properties of substances, and Category 7 is based on the effect of chemicals on human bodies. Based on its properties, a chemical might fit into more than one of these categories. The seven categories are:

**SLIDE****19**

1. Acids
2. Bases
3. Flammable
4. Oxidizers
5. Pyrophoric Substances
6. Light-Sensitive Chemicals
7. Carcinogens

In the following information, for each category, specific topics are covered: a general description of the category; some example chemicals; and safe storage requirements.

### 1. Acids

**SLIDE****20**

Acids come in several varieties. Some weak acids are often found in foods or in household cleaners. Examples are acetic acid in vinegar and citric acid in lemon juice. Note that pure acetic acid is a strong organic acid. Strong acids are very powerful substances that can cause severe burns, and acids can react violently with other substances. Strong acids are often used in industrial settings for cleaning, cutting, etching or for specific chemical reactions. Strong acids are especially destructive to metal.

Here are some pointers for safe storage of strong acids:

**SLIDE****21**

- Store large bottles of acids on a low shelf or in acid cabinets.
- Segregate oxidizing acids from organic acids, flammables and combustible materials.

- Segregate acids from bases and active metals such as sodium, potassium, etc.
- Use bottle carriers for transporting acid bottles.
- Have spill control pillows or acid neutralizers available in case of spill.

Some examples of strong acids are:

**SLIDE**

**22**

Strong Oxidizing Acids

Chromic Acid  
Nitric Acid  
Hydrobromic Acid  
Perchloric Acid  
Iodic Acid  
Sulfuric Acid

Organic Acids

Acetic Acid  
Phenol  
Benzoic Acid  
Trichloroacetic Acid

## 2. Bases

**SLIDE**

**23**

In many ways, bases are the chemical opposites of acids, and bases will react strongly if not violently with acids. Never combine strong acids and strong bases. The intense heating caused by the reaction can cause the mixture to explode and cause serious injury. Strong bases are often used in industrial settings for cleaning and production of other chemicals and products.

Here are some pointers for safe storage of strong bases:

**SLIDE**

**24**

- Store bases and acids separate from one another.
  - Store solutions of inorganic hydroxides in polyethylene containers.
  - Have spill control pillows or caustic neutralizers available for spills. (Spill control pillows are widely available. These pillows have cases of loosely woven polymer and are usually filled with highly absorbent materials. A particular pillow may not be appropriate for all spills. Check manufacturer specifications.)
-

Some examples of strong bases are:

**SLIDE**

**25**

Ammonium Hydroxide  
Calcium Hydroxide  
Bicarbonates  
Potassium Hydroxide  
Carbonates  
Sodium Hydroxide

### 3. Flammable Chemicals

**SLIDE**

**26**

Many materials are flammable, but some chemicals are dangerously flammable, either because they are easy to ignite, generate intense heat when ignited, or may explode if ignited. Common chemicals in this category are fuels and solvents, such as paint thinners, acetone, gasoline, or acetylene.

Workers and managers should also be aware of conditions that can lead to spontaneous combustion. This is a danger in many situations where a flammable material, such as hay, grain, flour, coal, or oil- or solvent-soaked rags or filters, are stored in bulk with too high a moisture content. Decomposition within the bulk of these materials, aggravated in some cases by solar heating, can raise internal temperatures to well above the flash point for the material, leading to spontaneous fires.

Here are some pointers for the storage of flammable materials:

**SLIDE**

**27**

- Store in approved safety cans or cabinets.
- Segregate from oxidizing acids and oxidizers.
- Keep away from any source of ignition: flames, heat or sparks.
- Know where fire fighting equipment is stored and how to use it.
- If volatile flammable liquids are stored in a refrigerator, it must be in an explosion-proof (lab-safe) refrigerator which is labeled "Not for Food Use."

Some examples of flammable materials are:

**SLIDE**

**28**

Flammable Solids  
Benzoyl peroxide  
Phosphorous, yellow  
Calcium Carbide  
Picric Acids

Flammable Liquids

Acetone  
Ether  
Gasoline

Flammable Gases

Acetylene  
Ethylene Oxide  
Ammonia  
Formaldehyde  
Butane  
Hydrogen  
Carbon Monoxide  
Hydrogen Sulfide  
Ethane  
Methane  
Ethyl Chloride  
Propane  
Ethylene  
Propylene

## 4. Oxidizers

**SLIDE****29**

This may be an unfamiliar category to you, however, oxidizers are powerful chemicals, and can react violently with common substances, possibly causing fires or explosions. Perchlorates and dichromates are especially dangerous if mishandled. Some of these chemicals can become less stable and more dangerous if stored for long periods of time. Strong oxidizers can react violently with organic materials, including latex, some plastics and skin.

Here are some pointers for storage of oxidizers:

**SLIDE****30**

- Store in a cool, dry place.
- Keep away from flammable and combustible materials, such as paper or wood.
- Keep away from reducing agents, such as zinc, alkaline metals, and formic acid.

Here are some examples of oxidizers:

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SLIDE

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Oxidizers - Solids  
Ammonium Dichromate  
Nitrates  
Ammonium Perchlorate  
Periodic Acid  
Ammonium Persulfate  
Permanganic Acid  
Benzoyl Peroxide  
Peroxides, Salts of Bromates  
Potassium Dichromate  
Calcium Hypochlorite  
Potassium Ferricyanide  
Chlorates  
Potassium Permanganate  
Chromium Trioxide  
Potassium Persulfate  
Ferric Trioxide  
Sodium Chlorite, Hypochlorite  
Ferric Chloride  
Sodium Dichromate  
Iodates  
Sodium Nitrate  
Iodine  
Sodium Perborate

## 5. Pyrophoric Substances

SLIDE

32

This is another less well-known category of chemicals. Pyrophoric substances tend to ignite when exposed to air. Due to their nature, their use is limited to very specialized operations, nonetheless, you should be aware of this kind of hazardous chemical. We can also include in this category many common substances in fine powder form. Such substances such as fine metal powders or finely ground flours can spontaneously ignite and produce significant explosions.

Here are some safety pointers for pyrophoric substances:

SLIDE

33

- Store in a cool place.
  - Store in containers that omit air.
  - Beware of low humidity circumstances in which static electricity may be high.
-

**SLIDE****34**

Here are some examples of pyrophoric substances:

Boron  
Cadmium  
Calcium  
Phosphorus, Yellow  
Diborane  
Dichloroborane  
2-Furaldehyde

## 6. Light-Sensitive Chemicals

**SLIDE****35**

Light-sensitive chemicals may change their composition if exposed to natural light. Often these changes lead to less stable and more dangerous substances.

Here are some safe storage tips for light-sensitive chemicals:

- Avoid exposure to light.
- Store in amber bottles in a cool, dry place.

**SLIDE****36**

Here are some examples of light-sensitive chemicals:

**SLIDE****37**

Bromine  
Oleic Acid  
Ethyl Ether  
Potassium Ferricyanide  
Ferric Ammonium Citrate  
Silver salts  
Hydrobromic Acid  
Sodium Iodide  
Mercuric Salts  
Mercurous Nitrate

## 7. Carcinogens

**SLIDE****38**

Carcinogens are chemicals that may cause cancer in humans. These chemicals can upset the normal growth of human tissues. Unlike the previous categories of chemicals, which can have immediate injurious effects, carcinogens often cause damage over a long period of time, usually through repeated, perhaps daily exposure. A single, intense exposure to

some of these chemicals can also have long-term consequences.

Cancer is not the only disease that chemicals can cause. You should be aware of the possible health effects of any chemical to which you may be exposed on a regular basis.

Here are some safe storage tips for carcinogens:

**SLIDE****39**

- Label all containers as Cancer Suspect Agents.
- Store according to hazardous nature of chemicals, e.g., flammable, corrosive.
- When necessary, store securely.

Some examples of carcinogens are:

**SLIDE****40**

Antimony compounds  
Acrylonitrile  
Arsenic compounds  
Benzene  
Benzidine  
Chloroform  
Beryllium  
Dimethyl Sulfate  
Cadmium compounds  
Dioxane  
Chromates, Salts of Ethylene Dibromide  
Beta-Naphthylamine  
Hydrazine  
Vinyl Chloride  
Nickel Carbonyl

## Section 7: Summary

**SLIDE****41**

### 1. Basic Rules of Chemical Safety

Rule #1: Don't buy or store chemicals you do not need.

Rule #2: Store chemicals in their original containers.

Rule #3: Always wear appropriate safety gear and work in a safe environment.

Rule #4: Always dispose of chemicals safely.

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**SLIDE****42**

**SLIDE****43**

## 2. Storage Issues that Cause Chemical Injury

- a. Improper or non-existent labeling of chemicals in storage.
- b. Storage of chemicals beyond the recommended shelf life.
- c. Degradation of chemical storage containers.

**SLIDE****44**

## 3. Health Effects of Chemicals

- a. Chemical Burns (strong acids, strong bases)
- b. Heat Burns (flammable materials)
- c. Poisoning (many chemicals are damaging or fatal if taken internally, whether by swallowing, injection, or leaching through skin)
- d. Chronic illness (long-term exposure to even low doses of certain chemical agents can lead to chronic health conditions)

**SLIDE****45**

## 4. Right-to-Know and MSDS

Employees have a right to know what chemicals they may encounter in their work, and they have the responsibility to follow all appropriate safety precautions.

Precautions and safe handling information are provided on the Material Safety Data Sheets (MSDS) that must be on file for every chemical used in that operation.

**SLIDE****46**

## 5. Chemical Categories

1. Acids
  2. Bases
  3. Flammable
  4. Oxidizers
  5. Pyrophoric Substances
  6. Light-Sensitive Chemicals
  7. Carcinogens
-

## Part 6 — Questions and Discussion

**SLIDE****47**

You may wish to have a discussion period where your audience can talk about what they have just learned. Be alert for misinformation that may be shared during this discussion. Here are some suggestions to start the discussion.

- Ask participants to share about chemicals they work with and precautions they take normally. Emphasize personal protective equipment (PPE) and a correct “safety attitude.”
- Ask participants to share stories about chemical injuries they are aware of.
- Ask the participants how what they have just learned will change their work habits.

## Part 7 — Post-Test

If you choose to administer the post-test, do so now. You have already prepared the audience for this when you administered the pre-test. Just remind them that it will take only a couple of moments.

## Part 8 — Session Evaluation

An evaluation form is supplied in this booklet. Ask participants to take a few minutes to fill out this form and turn it in. If you allow participants to fill these forms out at home and return them to you at a later time – even later in the workshop – the chances of getting any evaluations are greatly reduced.

## Part 9 — Adjourn

Thank the participants for their attention and encourage them to work safely with chemicals.

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## Additional Resources

### Farm \*A\*Syst and Home\*A\*Syst Risk Assessments

Farm\*A\*Syst can help you determine what risks – whether from livestock waste disposal, pesticide management or petroleum storage – could threaten your family’s health and financial security. A system of step-by-step fact sheets and worksheets helps you to identify the behaviors and practices that are creating those risks. The complete program is at: <<http://www.uwex.edu/farmasyst/>>.

In every home – large or small, new or old, city or country – there are potential risks to your family’s health and the environment. Home\*A\*Syst helps you identify these risks and take action. The complete program is at: <<http://www.uwex.edu/homeasyst/>>.

### “Protect the Eyes from Harm” — An Eye Safety Power Point

This presentation reviews possible eye hazards and means of eye protection and their relative benefits. Available at the Florida AgSafe Web site: <<http://www.flagsafe.ufl.edu>>, click on “Publications.”

**Agrochemicals and Security: Chemical Safety — Pre-test**

This pre-test is intended to gauge your level of knowledge before participating in the *Chemical Safety* training. Please answer all the following questions to the best of your ability.

1. All chemicals present possible \_\_\_\_\_.
  
2. Preventing chemical injuries results from safe...
  - 1) \_\_\_\_\_
  - 2) \_\_\_\_\_
  - 3) \_\_\_\_\_
  
3. Name one or more of the major ways that unsafe storage can cause chemical injuries.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
4. \_\_\_\_\_ provide safety information and appropriate precautions.
  
5. What is the most basic personal protective equipment that should always be used when handling any kind of chemical? \_\_\_\_\_
  
6. List one or more rules of chemical safety.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
7. Name one or more categories of dangerous chemicals.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Agrochemicals and Security: Chemical Safety — Post-test**

This post-test is intended to gauge your level of knowledge after participating in the *Chemical Safety* training. Please answer all the following questions to the best of your ability.

1. All chemicals present possible \_\_\_\_\_.
  
2. Preventing chemical injuries results from safe...
  - 1) \_\_\_\_\_
  - 2) \_\_\_\_\_
  - 3) \_\_\_\_\_
  
3. Name one or more of the major ways that unsafe storage can cause chemical injuries.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
4. \_\_\_\_\_ provide safety information and appropriate precautions.
  
5. What is the most basic personal protective equipment that should always be used when handling any kind of chemical? \_\_\_\_\_
  
6. List one or more rules of chemical safety.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
  
7. Name one or more categories of dangerous chemicals.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

## **Agrochemicals and Security: Chemical Safety — Answer Key**

1. All chemicals present possible hazards.
2. Preventing chemical injuries results from safe...
  - 1) storage
  - 2) handling
  - 3) disposal
3. Name one or more of the major ways that unsafe storage can cause chemical injuries.
  1. Improper or non-existent labeling of chemicals in storage.
  2. Storage of chemicals beyond the recommended shelf life.
  3. Degradation of chemical storage containers.
4. Material Safety Data Sheets (MSDS) provide safety information and appropriate precautions.
5. What is the most basic personal protective equipment that should always be used when handling any kind of chemical? Whatever is specified on the label
6. List one or more rules of chemical safety.

Rule #1: Don't buy or store chemicals you do not need.  
Rule #2: Store chemicals in their original containers.  
Rule #3: Always wear appropriate safety gear and work in a safe environment.  
Rule #4: Always dispose of chemicals safely.
7. Name one or more categories of dangerous chemicals.
  1. Acids
  2. Bases
  3. Flammable
  4. Oxidizers
  5. Pyrophoric Substances
  6. Light-Sensitive Chemicals
  7. Carcinogens

## Participant's Evaluation of *Chemicals and Safety*

Please circle the number that best expresses your opinions for each of the following statements. Circle only one number per question for questions 1 through 4.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The training unit's format was easy to follow.	1	2	3	4	5
2. The information presented is useful to me.	1	2	3	4	5
3. The time it took to complete the training session was acceptable.	1	2	3	4	5
4. As a result of this session, I understand better how to work with chemicals.	1	2	3	4	5
5. We welcome your comments about this program:					

Please use the back of this sheet for any further comments.

Thank you for your time!

# PowerPoint Slides 1-3

**Agrochemicals and Security**  
**Chemicals and Safety**



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**Learning Objectives**

- ▶ Understand that all chemicals present possible hazards.
- ▶ Understand that safe storage is an important issue.
- ▶ Understand that many chemical injuries result from improper storage.
- ▶ Know that employees have rights and responsibilities when working with chemicals.
- ▶ Know four basic rules of chemical safety.
- ▶ Be aware of the categories of dangerous chemicals and appropriate safety precautions.

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**Chemicals – Helpful and Harmful**



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# PowerPoint Slides 4-6

### Sample Pesticide Label

Directions

Personal Protective Equipment

Re-entry Statement

Storage & Disposal

Registry No. Manufacturer

Formulation

Ingredients

Child Warning

**"The Label is the Law."**

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### Chemical Labels

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### Basic Rules of Chemical Safety

**Be Aware!**  
**Be Alert!**  
**Be Alive!**

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## PowerPoint Slides 7-9

Basic Rules of Chemical Safety

**Rule #1**

**Don't buy or store chemicals you do not need.**



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Basic Rules of Chemical Safety

**Rule #2**

**Store chemicals in their original container.**



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Basic Rules of Chemical Safety

**Rule #2**

**Store chemicals in their original container.**

- The original container was designed to hold the chemical without degrading.
- The original container will have an accurate label.
- Serious injury can result when people try to identify chemicals with missing or uncertain labels by smelling, tasting or touching.



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## PowerPoint Slides 10-12

Basic Rules of Chemical Safety

**Rule #3**

**Always wear appropriate safety gear and work in a safe environment.**



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Chem-Safe-10

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Basic Rules of Chemical Safety

**Rule #4**

**Always dispose of chemicals safely.**



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**“Safe” Storage and Causes of Injury**



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Chem-Safe-12

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# PowerPoint Slides 13-15

"Safe" Storage and Causes of Injury

*Poor storage practices can cause injury:*

1. **Improper and non-existent labeling of chemicals in storage.**
2. **Storage of chemicals beyond the recommended shelf life.**
3. **Degradation of chemical storage containers.**



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"Safe" Storage and Causes of Injury

*Principle modes of chemical injury:*

1. **Chemical Burns** (strong acids, strong bases)
2. **Heat Burns** (flammable materials)
3. **Poisoning** (many chemicals are damaging or fatal if taken internally, whether by swallowing, injection, or leaching through skin)
4. **Chronic illness** (long-term exposure to even low doses of certain chemical agents can lead to chronic health conditions)



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"Safe" Storage and Causes of Injury

Learn good habits for working with chemicals from the beginning and practice these habits every day.



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## PowerPoint Slides 16-18

### Right-to-Know

*Right-to-Know laws mandate that employers:*

- **Inform employees about toxic chemicals they might be exposed to in their workplace.**
- **Provide training about safe handling practices and emergency procedures.**
- **Maintain MSDS for immediate access in the workplace/job site.**

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### Material Safety Data Sheets (MSDS)

Section 1 - Product and Company Identification  
 Section 2 - Composition/Information on Ingredients  
 Section 3 - Hazards Identification Including Emergency Overview  
 Section 4 - First Aid Measures  
 Section 5 - Fire Fighting Measures  
 Section 6 - Accidental Release Measures  
 Section 7 - Handling and Storage  
 Section 8 - Exposure Controls & Personal Protection  
 Section 9 - Physical & Chemical Properties  
 Section 10 - Stability & Reactivity Data  
 Section 11 - Toxicological Information  
 Section 12 - Ecological Information  
 Section 13 - Disposal Considerations  
 Section 14 - MSDS Transport Information  
 Section 15 - Regulatory Information  
 Section 16 - Other Information

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### Chemical Categories



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**PowerPoint Slides 19-21**

Chemical Categories

1. Acids
2. Bases
3. Flammable
4. Oxidizers
5. Pyrophoric Substances
6. Light-Sensitive Chemicals
7. Carcinogens



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Chemical Categories

**Acids**




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Chemical Categories: Acids

*Some pointers for safe storage of strong acids:*

- Store large bottles of acids on low shelf or in acid cabinets.
- Segregate oxidizing acids from organic acids, flammables and combustible materials.
- Segregate acids from bases and active metals such as sodium, potassium, etc.
- Use bottle carrier for transporting acid bottles.
- Have spill control pillows or acid neutralizers available in case of spill.



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## PowerPoint Slides 22-24

Chemical Categories: Acids

*Examples of strong acids:*

Strong Oxidizing Acids	Organic Acids
Chromic Acids	Acetic Acid
Nitric Acid	Phenol
Hydrobromic Acid	Benzoic Acid
Perchloric Acid	Trichloroacetic
Iodic Acid	
Sulfuric Acid	

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Chemical Categories

**Bases**



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Chemical Categories: Bases

*Some pointers for safe storage of strong bases:*

- **Store bases and acids separate from one another.**
- **Store solutions of inorganic hydroxides in polyethylene containers.**
- **Have spill control pillows or caustic neutralizers available for spills.**

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# PowerPoint Slides 25-27

Chemical Categories: Bases

*Examples of strong bases:*

- Ammonium Hydroxide
- Calcium Hydroxide
- Bicarbonates
- Potassium Hydroxide
- Carbonates
- Sodium Hydroxide



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Chemical Categories

### Flammable Chemicals



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Chemical Categories: Flammable

*Some pointers for storage of flammable materials:*

- Store in approved safety cans or cabinets
- Segregate from oxidizing acids and oxidizers.
- Keep away from any source of ignition: flames, heat or sparks.
- Know where fire fighting equipment is stored and how to use.
- If volatile flammable liquids are stored in a refrigerator it must be in an explosion-proof (lab-safe) refrigerator.



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## PowerPoint Slides 28-30

Chemical Categories: Flammable

Examples of flammable chemicals:

Flammable Solids	Flammable Gases
Benzoyl peroxide	Acetylene
Phosphorus (yellow)	Ethylene Oxide
Calcium Carbide	Butane
Picric Acids	Hydrogen
	Ethane
	Propane
	Ethylene

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Chemical Categories

Oxidizers



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Chemical Categories: Oxidizers

Some examples of oxidizers:

- **Store in a cool, dry place.**
- **Keep away from flammable and combustible materials, such as paper or wood.**
- **Keep away from reducing agents such as zinc, alkaline metals, formic acid.**

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## PowerPoint Slides 31-33

Chemical Categories: Oxidizers

*Examples of oxidizers:*

- Ammonium Dichromate
- Nitrates
- Ammonium Perchlorate
- Periodic Acid
- Ammonium Persulfate
- Permanganic Acid
- Benzoyl Peroxide

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Chemical Categories

**Pyrophoric Substances**



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Chemical Categories: Pyrophoric Substances

*Safety pointers for pyrophoric substances:*

- **Store in a cool place.**
- **Store in containers that omit air.**
- **Beware of low humidity circumstances in which static electricity may be high.**

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## PowerPoint Slides 34-36

Chemical Categories: Pyrophoric Substances

Some examples of pyrophoric substances:

- Boron
- Cadmium
- Calcium
- Phosphorus (yellow)
- Diborane
- Dichloroborane
- 2-Furaldehyde

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Chemical Categories

**Light-Sensitive Chemicals**

*Composition can change if exposed to light*

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Chemical Categories: Light-Sensitive Chemicals

Safety pointers for light-sensitive chemicals:

- Avoid exposure to light.
- Store in amber bottles in a cool, dry place.

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# PowerPoint Slides 37-39

Chemical Categories: Light-Sensitive Chemicals

Some examples of light-sensitive chemicals:

- Bromine
- Oleic Acid
- Ethyl Ether
- Potassium Ferricyanide
- Silver Salts
- Hydrobromic Acid
- Sodium Iodide

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Chemical Categories

Carcinogens



Biohazard

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Chemical Categories: Carcinogens

Safe storage pointers for carcinogens:

- Label all containers as Cancer Suspect Agents.
- Store according to hazardous nature of chemicals, e.g., flammable, corrosive.
- When necessary, store securely.

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## PowerPoint Slides 40-42

Chemical Categories: Carcinogens

Some examples of carcinogens:

- Antimony compounds
- Acrylonitrile
- Arsenic compounds
- Benzene
- Chloroform
- Dimethyl sulfate
- Dioxane
- Vinyl chloride



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Agrochemicals and Security: Chemicals and Safety

Summary



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1. Basic Rules of Chemical Safety

**Rule 1.** Don't buy or store chemicals you don't need.

**Rule 2.** Store chemicals in their original containers.

**Rule 3.** Always wear appropriate safety gear and work in a safe environment.

**Rule 4.** Always dispose of chemicals safely.



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## PowerPoint Slides 43-45

**Storage Issues That Cause Chemical Injury**

- a. Improper or non-existent labeling of chemicals in storage.
- b. Storage of chemicals beyond the recommended shelf life.
- c. Degradation of chemical storage containers.

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**2. Health Effects of Chemicals**

- a. Chemical Burns (strong acids, strong bases)
- b. Heat Burns (flammable materials)
- c. Poisoning (many chemicals are damaging or fatal if taken internally, whether by swallowing, injection, or leaching through skin)
- d. Chronic illness (long-term exposure to even low doses of certain chemical agents can lead to chronic health conditions)

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**3. Right-to-Know and MSDS**

- Employees have a right to know what chemicals they may encounter in their work, and they have the responsibility to follow all appropriate safety precautions.
- Precautions and safe handling information are provided on the Material Safety Data Sheets (MSDS) that must be on file for every chemical.

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## PowerPoint Slides 46-48

**Chemical Categories**

1. Acids
2. Bases
3. Flammable
4. Oxidizers
5. Pyrophoric Substances
6. Light-Sensitive Chemicals
7. Carcinogens

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Agrochemicals and Security: Chemicals and Safety

**Questions and Discussion**

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**Agrochemicals and Security: Chemicals and Safety**

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Carol J. Lehtola, Ph.D.  
John Robbins



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