Safe and Effective Use

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Introduction

The Pest Management Guide Series

The Virginia Pest Management Guide (PMG) series provides the latest recommendations for control of major pests: diseases, insects, nematodes, and weeds. Each guide is revised annually. The faculty of the Department of Entomology and the Department of Plant Pathology, Physiology, and Weed Science in the College of Agriculture and Life Sciences, Virginia Tech write the PMGs. These guides are produced for the public by Virginia Cooperative Extension.

Extension offices are located in 107 local county or city governmental units throughout Virginia. The agents and staff members of these units are dedicated professionals. They are part of a unique alliance between the United States Department of Agriculture, Virginia's land-grant universities, and local government.

These guides are not a comprehensive control plan for all pests in Virginia. However, they do provide recommendations for management of major pest problems. For specific recommendations beyond the scope of these guides, please contact the Extension specialist(s) associated with the particular commodity or specialty area.

The information in these guides is based on studies conducted by the Research and Extension Division of Virginia Tech, in cooperation with other land-grant universities, the USDA, and the pest management industry. The recommendations are developed on a statewide basis unless otherwise indicated. Exceptions are noted in the remarks columns of each guide. Information contained in these guides covers those pest management methods for which there is specific information regarding effectiveness under Virginia conditions.

Recommended chemicals are registered by the U.S. Environmental Protection Agency (EPA) and the Virginia Department of Agriculture and Consumer Services (VDACS). When used in accordance with label directions, residues should be within tolerance limits set by the EPA. Pesticide users must follow label directions with regard to application site(s), rates of application, number of applications, and minimum time interval between application and harvest. Violation of label directions may result in unsafe residues, fines to the applicator and grower, crop seizure, and loss of public confidence and product marketability.

Use pesticides only on labeled sites, and follow all label directions to the letter!

How To Get Help with a Pest or Pesticide Management Problem

The first rule in solving any problem is to identify the cause before you seek a solution. This rule is especially true for pest management. You MUST identify the pest before you make any attempt to control it. If you need assistance with pest identification, there is help available as close as your local Extension office. Local Extension offices are listed in the telephone directory. There is also a list of Virginia Cooperative Extension offices at www.ext.vt.edu/offices/ on the World Wide Web.

If a pest is especially difficult to identify or if you need more information, your agent will send a specimen and/or samples to Virginia Tech. Services available include: the Plant Disease Diagnostic Clinic, the Insect Identification Laboratory, the Weed Identification Laboratory, the Soil Testing Laboratory, the Forage Testing Laboratory, and the Pesticide Residue Laboratory. All samples should be sent by your local Extension office. One or more of these services may help to solve pest or pesticide management problems.

Alternative Pest Controls

Pest management includes more than the use of pesticides. Virginia agriculture employs a number of non-chemical methods including resistant varieties, cultural controls, and biological controls. Growers are encouraged to use non-chemical methods to manage pests whenever possible. Alternative controls are an integral part of any cropping system. However, where chemical controls are necessary, they must be used in such a way as to provide for a safe food supply, a clean and healthy environment for humans and wildlife, and a productive and profitable agricultural industry.

Integrated Pest Management (IPM)

Integrated Pest Management (IPM) combines all appropriate pest management techniques into a single, unified plan. The goal: to reduce pest populations and their damage to an acceptable level. Virginia Tech has developed a number of IPM programs for Virginia crops. These are available through Virginia Cooperative Extension. IPM programs save money by reducing the costs associated with chemical applications. However, IPM is a highly technical management system which depends upon scientific research data specific to the local pest population levels and habitats. Without sufficient data, which take time and resources to generate, IPM programs are not possible. In Virginia, IPM programs are not yet developed for all crops. However, there are active programs for many crops and pests. For more information on IPM, please contact your local Extension office.

Pesticide Management in Virginia

Virginia Cooperative Extension provides programs for the public in pest management and pesticide safety in the form of recommendations and educational opportunities. Examples are commodity production meetings and pesticide safety workshops, including pesticide applicator training and recertification.

Issues and programs such as farmworker protection, recordkeeping, endangered species protection, food and water quality, and re-registration of pesticides mean additional state and federal regulations impacting pesticide users. In Virginia, the Virginia Pesticide Control Act and regulations promulgated under the act affect growers and commercial pesticide applicators. The Virginia Pesticide Control Act created the Virginia Pesticide Control Board to oversee pesticide management in the Commonwealth. State and federal pesticide laws and regulations are enforced by the Virginia Department of Agriculture and Consumer Services, Office of Pesticide Services.

Growers and applicators are responsible for meeting all requirements imposed by state and federal agencies. For more information about new programs, laws, and regulations, please keep in touch with your local Extension office.

Pesticide Applicator Certification

The Virginia Department of Agriculture and Consumer Services is responsible for the certification of applicators and for all enforcement aspects of the Federal Insecticide, Fungicide, and Rodenticide Act, the Virginia Pesticide Control Act, and regulations promulgated by the Virginia Pesticide Control Board.

In Virginia, certification is required for most commercial pesticide users, all aerial applicators, and growers who use restricted-use pesticides. The Virginia Pesticide Control Act and regulations drafted under the act define "pesticide use" as actual application, supervision of an application, or commercial recommendation of a pesticide. This includes the routine activities that are part of a pesticide application, such as mixing, loading, clean-up, and disposal. Handling, transfer, or transport after the manufacturer's original seal is broken is considered "use." (Pesticide handling typically managed by persons other than the mixer/loader/applicator, such as long-distance transport, long-term storage, or ultimate disposal, is not considered part of routine use.)

Before preparing for certification, you must first decide if you plan to become a Private Applicator, Commercial Applicator, or Registered Technician. Private and Commercial Applicators must be certified in one or more categories, based on the type(s) of pesticide use planned.

Types of Pesticide Applicators

Three general types of certified pesticide applicator are recognized by the Commonwealth of Virginia. Each is described below. Persons engaged in several sorts of pesticide-related activities may need to be certified as both a private and a commercial applicator.

Certified Private Applicator

A certified applicator who uses or supervises the use of any restricted-use pesticide (RUP) to produce an agricultural commodity. Applications must be made on property owned or rented by the user or his/her employer; or, if applied without compensation other than trading of personal services between producers of agricultural commodities, on the property of another person. Noncertified applicators employed by agricultural producers may use RUPs only when under the direct supervision of a certified Private Applicator. Direct supervision, in this case, means the RUP is used by a competent person who is acting under the instructions and control of a certified Private Applicator. The certified Private Applicator is responsible for the actions of the

uncertified farmhand. The certified Private Applicator who is in charge of the pesticide use must either be in close proximity to the pesticide user or within telephone or radio contact.

Commercial Applicator

A person using any pesticide for any purpose on the job other than as described for a Private Applicator (production of an agricultural commodity on property the grower owns or leases). Most commercial applicators must be certified. There are two certification options: Commercial Applicator or Registered Technician.

Certified Commercial Applicator

A person who has fulfilled the competency requirements set for Commercial Applicators in Virginia to use or supervise the use of any pesticide for any purpose or on any property on the job other than as described for a Private Applicator.

Certified Registered Technician

An individual who performs services similar to those of a certified Commercial Applicator. Such a person has completed training and demonstration of those competency standards required for Registered Technicians but not the requirements for Commercial Applicator certification. (Registered Technician trainees receive general pesticide safety training and job-specific instruction in pesticide use.) Registered Technicians may apply general-use pesticides without supervision. They may apply restricted-use pesticides under the direct supervision of a certified Commercial Applicator. Registered Technicians who work for hire must work for a licensed Pesticide Business.

Pesticide applicator training manuals are sold at cost by Virginia Tech. Manual order forms are available from your local Virginia Cooperative Extension Office, Virginia Tech Pesticide Programs, Virginia Department of Agriculture and Consumer Services Offices of Pesticide Services, or theVirginia Cooperative Extension Distribution Center. Please mail completed order forms, with payment, to the Distribution Center at the address below.

Virginia Cooperative Extension
Distribution Center
112 Landsdowne Street (0512)
Blacksburg, VA 24061

Certification procedures differ for Private Applicators, Commercial Applicators, and Registered Technicians. For the most up-to-date information about certification requirements, categories, initial certification procedures, and how to keep a certificate in force, contact your local Extension office, Virginia Tech Pesticide Programs, or VDACS Office of Pesticide Services.

Pesticide Laws, Regulations, and Restrictions

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) has been amended several times since it was passed in 1947. The amendments to this act are some of the most significant laws impacting American agriculture.

The 1972 amendment is known as the Federal Environmental Pesticide Control Act (FEPCA). FEPCA stipulates that the use of any pesticide inconsistent with its labeling is prohibited; that violations of FEPCA by growers, applicators, and dealers can result in heavy fines and imprisonment; that pesticides must be classified for either general use or for restricted use; that anyone using or purchasing restricted-use pesticides must be certified by their state of residency; that pesticide manufacturing plants must be inspected by the EPA; that states may register pesticides on a limited basis for special local needs; that all pesticides must be registered by the EPA; that all product registrations must be backed by scientific evidence to control the pests on the label; not injure people, crops, animals, or the environment; and not result in illegal residues in food and feed when used according to label directions.

The 1978 amendment was designed to improve the registration processes. It stipulates that efficacy data can be waived and that generic standards can be set for active ingredients rather than for each product. Re-registration of older products is required to make certain that scientific data exists to back them. Pesticides can be given a conditional registration prior to full registration. Registrants can use supporting data supplied from other companies if paid for. Trade secrets are to be protected. States have primary enforcement responsibility for both federal and their own state pesticide laws and regulations. States can register pesticides under a Special Local Needs (SLN or 24C) label. Finally, the phrase “to use any registered pesticide in a manner inconsistent with its labeling” was defined in detail.

It is illegal to use a pesticide in any way not permitted by the labeling. A pesticide may be used only on the plants, animals, or sites named in the directions for use. You may not use higher rates or more frequent applications. You must follow all directions for use, including directions concerning safety, mixing and loading, application, storage, and disposal. You must wear the specified personal protective equipment. Pesticide use directions and label instructions are not advice, they are legal requirements. Persons who derive income from the application, recommendation, sale, or distribution of pesticides CANNOT make recommendations which call for uses inconsistent with labeling.

However, federal law does allow you to use some pesticides in ways not specifically mentioned in the labeling. You may: apply a pesticide to control a pest not listed on the label (as long as the application is made in accordance with label directions); use any appropriate equipment or method of application not specifically prohibited by the label; mix two or more pesticides if not prohibited by one or more labels and all the dosages are at or below the label rate; and mix a pesticide or pesticides with fertilizer if the mixture is not prohibited by the labeling.

A major change to FIFRA, provided by the 1988 amendment, requires EPA to accelerate the re-registration of all pesticide products registered prior to 1978. As a result, some older pesticide registrations are being dropped due to the cost of supporting their re-registration. Many of the uses that will not be re-registered are for minor crops and specialty uses.

The Food Quality Protection Act (FQPA) of 1996 amends both the Federal Food, Drug, and Cosmetic Act (FFDCA) and FIFRA. FQPA provides a unified, comprehensive regulatory plan for pesticides. Because it requires the EPA to consider pesticide use and safety data in new ways, it may result in significant changes in U.S. pesticide use patterns.

The Virginia Pesticide Control Act

The Virginia Pesticide Control Act is enforced by the Virginia Department of Agriculture and Consumer Services (VDACS). The act and regulations which support it affect pesticide use in Virginia. Information concerning regulatory changes impacting pesticide user is available from Virginia Tech, VDACS, and your local Extension office.

Responsibilities of Pesticide Applicators in Virginia

I. Follow the Pesticide Label

The pesticide label is a legal agreement between the Environmental Protection Agency (EPA), the product manufacturer, and the user. Pesticide product labels provide instructions for all stages/phases of use. Applicators must read, understand, and follow label directions carefully. Pesticides may not be applied to any site not listed on the product label. Materials may not be applied more often, or at rates higher, than the label directs. Pesticide applicators are bound to follow all label directions for transport, mixing, loading, application, storage, and disposal of pesticide products and containers. State and federal laws prohibit the use of any pesticide in a way that is not consistent with its label. There are state and federal penalties for violations.

II. Adhere to Certification Requirements

Pesticide use means actual application and/or supervision of an application. "Use" includes the routine activities that are part of a pesticide application, such as mixing, loading, cleanup, and disposal. Handling, transfer, or transport after the manufacturer's original seal is broken is considered "use." (Pesticide handling typically managed by persons other than the mixer/loader/applicator—such as long-distance transport, long-term storage, or ultimate disposal—is not considered part of routine use.)

Private Applicators:

- In Virginia, a private applicator is a person engaged in producing an agricultural commodity on private property (owned, rented, or leased by the producer).
- Growers using restricted-use pesticides (RUP) must be certified or work under the direct supervision of a certified private applicator.

Commercial Applicators:

- The Virginia Pesticide Control Act defines a person who, as part of his or her job duties, uses or supervises the use of any pesticide for any purpose (other than production of agricultural commodities on private land) as a commercial pesticide applicator.

- Certification options for commercial applicators:
  - registered technician
  - commercial applicator
- Certification requirements depend on the commercial applicator class and scope of pesticide use. In addition, The Virginia Business License Regulation requires that people who make recommendations for-hire be certified. There are four classes of commercial applicator:
  - *Government employees* must be certified to use any pesticide for any purpose.
  - *For-hire* commercial applicators must be certified to use any pesticide for any purpose, and to make recommendations for hire (ex. as a crop consultant).
  - *Not-for-hire* commercial applicator certification requirements vary. People who do not work for hire but do use pesticides on the job must be certified if:
    - Using restricted-use pesticides, or
    - Using pesticides on the sites in the following list:
      - on any area open to the general public at the following establishments:
        - * Educational institutions,
        - * Health-care facilities,
        - * Day-care facilities, or
        - * Convalescent facilities;
      - where open food is stored, processed or sold; or
      - on any recreational land over five acres.
  - *Inactive* status is a way to maintain certified applicator status while not employed as a pesticide user.

The Virginia Department of Agriculture and Consumer Services (VDACS) is responsible for the certification of applicators and for all enforcement aspects of the Virginia Pesticide Control Act and regulations promulgated by the Virginia Pesticide Control Board (VPCB).

Certificates may be suspended or revoked if the holder, in the eyes of VDACS, presents a substantial danger or threat of danger to public health and safety or to the environment. A suspension may be issued on an emergency basis, and a certificate may be revoked after a hearing has taken place. If a person's certificate is revoked, he or she may not reapply for Virginia certification for two years.

Persons who have a history of repeat violations of any federal, state, or local pesticide law may not apply for certification. In addition, persons who have had a Virginia applicator certificate revoked may not be granted certification within a two-year period following that action. However, persons in either of these circumstances may petition the VPCB for certification.

III. Keep Your Certificate in Force

A. Renewal of Certificates

Commercial: Certified applicator and registered technician certificates must be renewed biennially. VDACS will send each commercial applicator a notice regarding renewal in the spring before his or her certificate expires.

A renewal form and a renewal fee must be received on or before June 30 to avoid a penalty. The renewal fee is $70.00 for a commercial applicator and $30.00 for a registered technician. The renewal fee and application requirement is waived for federal, state, and local governmental employees requiring commercial applicator certification.

Commercial certificates expire June 30. No late renewals will be accepted after August 29. Applications for renewal will not be processed unless the applicator has at least two years of recertification credit in the appropriate category or categories.

Persons who allow their certificate(s) to lapse more than 60 days must retest in Core (basic safety) as well as in the appropriate category or categories.

Applicators must inform Virginia Department of Agriculture and Consumer Services Office of Pesticide Services (OPS) Certification, Licensing, Registration, and Training Section if their mailing address or employment status changes.

Private: Private applicator certificates are automatically renewed biennially at recertification. There is no fee. Private applicator certificates expire on December 31, two years following issue. Late renewals will not be accepted after March 1.

B. Recertification

Private and commercial applicators and registered technicians must participate in an ongoing pesticide education program. At a minimum, commercial applicators and registered technicians must attend at least one fully approved recertification session per category every two years. Private applicators must accumulate three credits per category every two years. Applicators may accumulate up to four years of recertification credit. Persons who fail to recertify will not be able to renew their certificates.

Virginia Cooperative Extension (VCE), pesticide-related trade and professional organizations, and others offer recertification courses. A listing of all Virginia-approved courses may be obtained from:

Virginia Cooperative Extension offices or
Virginia Tech Pesticide Programs (VTPP) Unit:
www.vtpp.ext.vt.edu/ (private applicator courses; searchable database)

VDACS/OPS/Certification, Licensing, Registration, and Training Unit:
www.vdacs.virginia.gov/pesticides/categories.html (commercial applicator courses, listed by category)

Program availability varies by time of year and by category. Most courses are offered between September and March. Applicators are advised to keep in touch with Virginia Cooperative Extension and/or professional organizations to avoid missing recertification opportunities.

Certified applicators based out of state may be able to become certified and recertify in Virginia by reciprocity. Contact the Virginia Department of Agriculture and Consumer Service Office of Pesticide Services for more information.

Failure to maintain a certificate, either due to failure to respond to the renewal notice or failure to recertify, will result in expiration. Persons who allow their certificate(s) to lapse (for more than 60 days) must retest in Core (basic safety) as well as in the appropriate category or categories. Commercial applicators and registered technicians who choose to recertify by re-examination or who must be examined to reactivate a lapsed certificate must apply for examination and pay an application fee.

Applicators must inform VDACS/OPS if their address or employment status changes.

IV. Supervise Employees

A. Registered Technicians by Commercial Applicators

Certified commercial applicators must provide on-the-job training, instruction, and supervision of registered technicians employed by them or assigned to them by their employer. Registered technicians may use restricted-use pesticides only under the supervision of a commercial applicator. The supervising commercial applicator must either be physically present or be where the registered technician may contact the applicator by telephone or radio. Certified applicators are responsible for the work of registered technicians under their supervision and must provide the registered technicians with clear, specific instructions on all aspects of pesticide use. A registered technician may apply general-use pesticides unsupervised.

Uncertified persons may apply pesticides commercially while in training to become registered technicians *only* when under the direct, *on-site* supervision of a certified commercial applicator.

B. Uncertified Handlers by Private Applicators

Uncertified but competent persons may apply restricted-use pesticides in the production of agricultural commodities on private property when under the direct supervision of a certified private applicator. The certified private applicator is responsible for the actions of the uncertified person.

Direct supervision means the act or process by which the application of a pesticide is made by a competent person acting under the instructions and control of a certified applicator who is responsible for the actions of that person. The certified applicator must be accessible to the applicator by being nearby or within reach by telephone or radio.

V. Handle Pesticides Safely

Although there are no specific storage and disposal regulations in Virginia, unsafe use/handling/storage/disposal practices can be cited under the enforcement regulation: 2 VAC 20-20-10 through 20-220 (VAC is the Virginia Administrative Code).

Provisions to Note:

Handling and Storage:

"No person shall handle, transport, store, display, or distribute pesticides in a manner which may endanger humans or the environment, or food or feed or other products…"

Disposal:

"No person shall dispose of, discard, or store any pesticide or pesticide containers in a manner that may cause injury…or pollute…"

Application Equipment:

"…must…be in good working order…dispense the proper amount of material…be leakproof…have cutoff valves and backflow prevention…"

Service Container Labeling:

Containers other than the original registrant's or manufacturer's containers used for the temporary storage or transportation of pesticide concentrates or end-use dilutions must have abbreviated labeling for identification.

A. Pesticide Concentrate:

1. If the pesticide to be temporarily stored or transported is a concentrate to be further diluted, the container shall bear a securely attached label with the following information:

   a. Product name or brand name from product label;

   b. EPA registration number from the product label;

   c. Name and percentage of active ingredient(s) from the product label; and

   d. Appropriate signal word; i.e., Poison, Danger, Warning, Caution (from the product label).

2. The above labeling is required for concentrate service containers, regardless of container type, size, or capacity. (Note: If possible, keep pesticides in their original container.)

B. Pesticide End-Use Dilutions or End-Use Concentrates:

1. If the pesticide to be temporarily stored or transported will be applied without further dilution, its container must bear a securely attached label with the following information:

   a. Product name (brand name from product label) preceded by the word "Diluted" or "End-Use Concentrate";

   b. EPA registration number from the concentrate product label;

c. Name of active ingredient(s) and percentage(s) of end-use dilution; and

d. Appropriate signal word; i.e., Poison, Danger, Warning, Caution (from the product label).

2. Exemptions: abbreviated service container labeling is not required for:

a. End-use dilution containers not exceeding 3 gallons liquid or 3 pounds dry capacity, when such containers are used as application devices; i.e., hand-held sprayers, dusters, puffers, etc.

b. Containers used by farm-supply dealers for the temporary storage or transportation of pesticide concentrate or end-use dilution, provided that sales invoices or delivery tickets adequately identifying the pesticide(s) accompany each shipment or delivery.

c. Farm concentrate or end-use dilution containers or application equipment used for the temporary storage or transportation of such pesticides for agricultural use.

d. Aircraft-mounted containers used for temporary storage or transportation of concentrate or end-use dilution pesticides, provided that aircraft logs or other documents on board adequately identify the pesticide(s).

VI. Keep Accurate Records

A. Commercial Applicators

Virginia regulations require all commercial applicators to keep records of all pesticide applications. These records must be maintained for two years following the pesticide use. Commercial applicator records must contain the following information:

1. Name, address, and telephone number (if applicable) of the treatment site property owner, and address/location of the application site, if different;

2. Name and certification number of the person making or supervising the application;

3. Date of application (day, month, year);

4. Type of plants, crops, animals, or sites treated;

5. Principal pest(s) to be controlled;

6. Acreage, area, or number of plants or animals treated;

7. Identification of pesticide used:

-Brand name or common name of pesticide used, and

-EPA product registration number;

8. Amount of pesticide concentrate and amount of diluent (water, etc.) used, by weight or volume, or the volume and concentration applied to a structure as defined in #6; and

9. Type of application equipment used.

Commercial applicators and WPS compliance:

Commercial applicators who apply pesticides to agricultural commodities on farms, forests, nurseries, and greenhouses should be sure their record data elements conform to those required by both the **Worker Protection Standard (WPS)** and the **Food, Agriculture, Conservation, and Trade (FACT) Act**, also known as the 1990 Farm Bill.

- If a grower hires a commercial applicator to apply an RUP, the commercial applicator is responsible for making and maintaining the application records required by the FACT Act.

- If a grower with farm-worker or pesticide-handler employees hires a commercial applicator to apply any pesticide, the commercial applicator must provide the grower with information about the application in advance. This is necessary so that the grower can comply with WPS notification, restricted-entry, and record-keeping requirements.

A sample commercial applicator record-keeping form follows at the end of this section.

B. Private Applicators

The Food, Agriculture, Conservation and Trade (FACT) Act of 1991, also known as the 1990 Farm Bill, requires certified private pesticide applicators to record applications of restricted-use pesticides (RUPs). RUP applications made by a private applicator must be recorded within 14 days and maintained for a period of two years. Private Applicator records must contain the following nine data elements:

1. The restricted-use pesticide brand or product name;

2. The EPA registration number;

3. The total amount of the restricted-use pesticide product applied;

4. The month, day, and year of application;

5. The location of the treated area;

6. The crop, commodity, stored product, or site to which the restricted-use pesticide was applied;

7. The size of area treated;

8. The name of the certified applicator who applied or supervised the application of the restricted-use pesticide; and

9. The certificate number of the person named in number 8, who made or supervised the application.

Records of spot-treatments may require less information. A spot application is a treatment of an area totalling less than one-tenth of an acre made on the same day. For spot applications record:

1. Brand or product name;

2. EPA registration number;

3. Total amount applied;

4. Month, day, and year of application; and

5. Location of treated area, designated as a "spot application" (with a brief but concise description of the site).

Recording the name and certificate number of the certified private applicator who made or surpervised the RUP spot treatments is recommended, although it is not required by federal law.

(Note: ***Nursery and greenhouse RUP applications do NOT qualify as spot treatments. Greenhouse and nurseries must record all required recordkeeping data elements.*****)**

Certified applicators are required to make records available, upon request, to any Federal or State agency that deals with pesticide use or any health or environmental issue related to the use of restricted-use pesticides. In addition, medical professionals need access to records in the event of an exposure.

The certified applicator who applies a RUP is responsible for making and maintaining the application records required by the FACT Act. However, if a grower hires a commercial applicator to apply a RUP, the commercial applicator is responsible for the FACT Act recordkeeping.

The FACT Act requires commercial applicators to provide a copy of a restricted-use pesticide application record to the person for whom the application was made within 30 days of the application. However, if a private applicator has employees, he/she should obtain the record information prior to any for-hire application — RUP or not — to ensure compliance with WPS posting and notification requirements.

The Federal Worker Protection Standard (WPS) also involves some recordkeeping. Growers who employ field workers or pesticide handlers must display pesticide use and safety information at a central location. WPS requires growers who employ agricultural workers to make, maintain, and post pesticide application records. WPS application records must be kept for every pesticide used on the farm, not just for those that are restricted-use. A WPS application list must record:

1. Brand or product name;
2. EPA registration number;
3. Active ingredient(s) of the product used;
4. Location of the treated area;
5. Time and date the application is scheduled; and
6. Restricted entry interval for the pesticide (duration and expiration).

WPS application records must be completed prior to the application. They must be displayed for 30 days following the application. WPS application records are part of a broader requirement to provide safety information for agricultural employees at a central location. This includes pesticide use information (in the form of an up-to-date application list), emergency information, and an EPA-approved pesticide safety poster. You will find more information about WPS in the Virginia Core Manual, *Applying Pesticides Correctly*. Detailed information about WPS may be found in EPA's manual: *The Worker Protection Standard for Agricultural Pesticides — How to Comply.*

Please keep in touch with your local Extension agent for the latest information on record keeping. Your agent will also know about WPS and other pesticide laws and regulations affecting agricultural producers. A sample record-keeping form for producers follows at the end of this section.

Table 1.1 - Pesticide Application Record for Agricultural Producers in Virginia

Note: WPS requires posting of all pesticide application information at a central location for 30 days after the restricted-entry interval expires. USDA records of restricted-use pesticide applications must be kept for two years.

[3]Year Mo/Date / [1]Time of Day	[2]Crop or Commodity	[3]Location & Description of Treated Area	[3]Brand or Product Name	[1]Active Ingredient Common Name	[3]EPA Registration Number	[2]# of Units or Acres Treated	[2]Total Amount of Product Used (oz., lb., pt., qt., gal.)	[2]Applicator Information: (Name & Certificate No.)	[1]Restricted-Entry Interval (REI)	
									Duration (Hours)	Expiration (Mo/Date/ Time)

[1]Required for Worker Protection Standard

[2]Required for Federal Pesticide Recordkeeping Requirements, USDA

[3]Required for Worker Protection Standard and Federal Pesticide Recordkeeping Requirements

Prepared by Virginia Cooperative Extension and VDACS (Virginia Department of Agriculture and Consumer Services), Office of Pesticide Services, 1999.

Table 1.2 - Commercial Applicator Pesticide Application Record for:

Note: The Commonwealth of Virginia requires commercial applicator records of pesticide applications to be kept for two years.

Name, Address, and Telephone Number of Property Owner	Address and Location of the Application Site (if different than recorded in left column)	Certified Applicator's Name and Certificate Number	Date: (Month, Day, Year)	Type of Plants, Crops, Animals, or Sites Treated	Principal Pest to be Controlled	Acreage, Area, or Number of Plants or Animals Treated	Brand or Common Name of Pesticide	EPA Product Registration Number	Total Amount of Product *and* of Diluent (if used)	Type of Application Equipment

Prepared by Virginia Cooperative Extension and VDACS (Virginia Department of Agriculture and Consumer Services) Office of Pesticide Services, 2006.

VII. Report Pesticide Accidents

Pesticide accidents or incidents that constitute a threat to any person, to public health or safety, and/or to the environment must be reported. Initial notification must be made by telephone within 48 hours of the occurrence. A written report describing the accident or incident must be filed within 10 days of the initial notification.

Telephone contacts and written reports should be directed to:

Virginia Department of Agriculture and Consumer Services
Office of Pesticide Services/Enforcement and Field Operations
P. O. Box 1163, Richmond, VA 23218
(804) 371-6560

If the accident or incident involves a spill, the applicator should contact VDACS/OPS to determine whether the release is governed under SARA Title III (the Community Right-to-Know Law). The chemical hazard and the volume of the released chemical determine reporting under SARA Title III. If so, the applicator must also notify the National Response Center at 1-800-424-8802.

In the event of an emergency release that would harm other people or property, notify the Virginia Department of Emergency Management (VDEM) Operations Center at 1-800-468-8892.

VIII. Obtain a Pesticide Business License

Certified commercial applicators working *for hire* must have a pesticide business license or work for someone who does. Registered technicians working *for hire* must work for a properly licensed pesticide business.

The Virginia Department of Agriculture and Consumer Services is responsible for all enforcement aspects of the Virginia Pesticide Control Act and regulations promulgated by the Virginia Pesticide Control Board. Business licenses may be suspended or revoked if the holder, in the eyes of VDACS, presents a substantial danger or threat of danger to public health and safety or to the environment.

IX. Ensure Financial Responsibility

The commercial applicator *for hire,* or his/her employer, must provide VDACS with evidence of financial responsibility protecting persons who may suffer legal damages as a result of use of any pesticide by the applicator. The coverage must provide for liability that may result from the operation of a pesticide business and for liability relating to completed operations (for businesses that *apply* pesticides). The Commonwealth insures Virginia's state employees for activities performed as official job duties.

Sources of Information

Questions regarding federal and state pesticide regulations, the legal responsibilities of pesticide users, and certificate/license status:

Virginia Department of Agriculture and Consumer Services (VDACS)
Office of Pesticide Services (OPS)
P.O. Box 1163
Richmond, VA 23218

(804) 371-6558 / (800) 552-9963
www.vdacs.virginia.gov/pesticides/

Questions regarding federal and state pesticide regulations, legal responsibilities of pesticide users, pesticide management techniques, and sources of approved preparatory training sessions and recertification workshops:

Virginia Cooperative Extension (VCE)
Virginia Tech Pesticide Programs
305 Sandy Hall (0409)
Virginia Tech
Blacksburg, VA 24061

(540) 231-6543
www.vtpp.ext.vt.edu/ or *vtpp.org*

Pest management information available on the World Wide Web from Virginia Tech:

Department of Entomology: *web.ento.vt.edu/ento/*

Department of Plant Pathology, Physiology, and Weed Science: *www.ppws.vt.edu/*

The Hazard Communication Standard

As of May 23, 1988, all employers must adhere to restrictions under the OSHA Hazard Communication Standard. This standard is a worker right-to-know law, which requires employers to train and inform all workers who may be potentially exposed to hazardous chemicals in the workplace. The new law especially targets operations, including agricultural operators, with 10 or more employees. These employers must file a Hazard Communication Plan in their offices and inform their employees of the content of this plan. These employers must obtain and file Material Safety Data Sheets (MSDS) for all chemicals used by their employees. In addition, employers must provide training on the information in the plan, the MSDS, and chemical labeling to each employee who may be potentially exposed to a chemical hazard. This training is very specific to each operation and therefore must be conducted by the employer. Also, when new chemical hazards are introduced into the workplace, the employer must provide new training to protect the employee.

For agricultural operators with fewer than 10 employees, it is not necessary to develop and file a Hazard Communication Plan. However, MSDS and Labeling should be maintained, and employees must be informed of proper use and safe handling according to the MSDS and labeling information. For more information on the standard, contact your local Extension office or the Virginia Department of Labor and Industry. A manual explaining how to comply and develop a training program is available by contacting the Virginia Department of Labor and Industry, VOSHA Consultation Services, 13 South 13th Street; Richmond, VA 23219-4101; (804) 786-5873, *www.doli.state.va.us/*

Community Right To Know (SARA Title III)

The Superfund Amendments and Reauthorization Act of 1986 (SARA Title III) was drafted to require industries and others producing or storing hazardous chemicals to provide communities with the identity and amounts of chemicals located in their vicinity. The law also addresses the need for communities to establish emergency response plans to follow in the event of an emergency.

Each local government in Virginia has an Emergency Response Council to deal with reporting and notification under SARA Title III. These councils are made up of local government officials who should be able to advise you on how to deal with compliance associated with local requirements under the statute.

For the farmer, this law requires you to notify local authorities if you store any chemical listed under Section 302 of the Act. This list is extensive, and the amount stored before notification is according to a Threshold Planning Quantity (TPQ) specific to each chemical active ingredient. Examples of pesticides, listed according to pounds of active ingredient **(not formulated product or diluted chemical)**, include:

If you store one or more pounds of:

aldicarb (Temik)
aldrin
azinphos-methyl (Guthion)
carbophenothion (Trithion)
chlordane
chlorfenvinfos (Birlane, Supona)
chlorophacinone (Rozol)
chloroxuron (Tenoran)
coumafuryl (Fumarin)
cycloheximide (Acti-dione)
demeton (Systox)
demeton-s-methyl (Metasystox-R)
dirotophos (Bidrin)
dioxathion (Delnav, Deltic)
disulfotan (Di-Syston)
endosulfan (Thiodan)
EPN
fensulfothion (Dasanit)
fonofos (Dyfonate)
lindane
methamidophos (Monitor)
methidathion (Supracide)
monocrotophos (Azodrin)
nicotine sulfate (Black Leaf 40)
oxamyl (Vydate)
oxydisulfoton (Di-Syston)
paraquat (Gramoxone Super)
parathion
pentachlorophenol (Penta, PCP)
phosmet (Imidan)
phosphamidon (Dimecron)
pirimiphos-ethyl (Primidid)
promecarb (Carbamult)
sodium cacodylate (Broadside, Phytar 56)
sulfur dioxide
terbufos (Counter)
trichloronate (Agritox)

If you store ten or more pounds of:

carbofuran (Furadan)
carbon disulfide
coumaphos
dichlorvos (DDVP, Vapona)
dimethoate (Cygon, De-fend)
dinitrocresol (DNOC)
ethion
methiocarb (Mesurol)
mevinphos (Phosdrin)
phorate (Thimet)
sodium cyanide (Cymag)
sodium fluoroacetate
strychnine
TEPP

If you store 100 or more pounds of:

aluminum phosphide (Phostoxin)
methomyl (Lannate, Nudrin)
methyl isothiocyanate (Vorlex)
methyl parathion (Penncap-M)
nicotine
sulfotep (Bladafume)
trichlorfon (Dylox, Proxol)
warfarin (Co-Rax, Rodex)
zinc phosphide (Phosvin, ZP)

If you store 1,000 or more pounds of:

dinoseb (Premerge, Dinitro)
methyl bromide
mexacarbate (Zectran)
sodium arsenate (Atlas "A," Penite)
sodium arsenite
sodium azide

The amount of formulated product that may be stored but not reported depends on the active ingredient itself and percent active ingredient in the product. If a product was 10 percent active ingredient and the TPQ was 10 pounds, then you could store up to 100 pounds of the formulated product before you would be required to report to local authorities.

In the event of any spill, you are advised to contact local authorities immediately. In addition, spills must be reported to VDACS Office of Pesticide Services at (804) 371-6560. If the spill is of a reportable quantity (information available from VDACS), then contact the National Response Center (800) 424-8802.

The law also requires notification in the event of an emergency release which would impact others or other property (spill, drift, etc.) to the state Emergency Response Center (Virginia Department of Emergency Management [DEM]) at (800) 468-8892.

Worker Protection Standard for Agricultural Pesticides

The EPA's Worker Protection Standard for Agricultural Pesticides (WPS) was developed to protect workers and pesticide handlers from exposures to agricultural pesticides, thus reducing the risks of pesticide poisonings and injuries. The WPS targets workers who perform hand-labor operations in agricultural fields, nurseries, greenhouses, and forests treated with pesticides. It also impacts employees who handle pesticides (mix, load, apply, etc.) for use in those locations. Labels of pesticides used in agricultural plant production, nursery/greenhouse operations, and forestry refer to WPS requirements.

WPS has requirements referenced ***(but NOT explained in detail)*** on pesticide labels. A "How to Comply" manual and other materials are available from the EPA Certification and Worker Protection Branch: (703) 305-7666. If you have questions about the WPS, please contact your local Extension agent or call the Virginia Department of Agriculture and Consumer Services/ Office of Pesticide Services at (804) 371-6558.

Groundwater Restrictions

The EPA and Congress have placed special emphasis on protection of water resources. Water quality programs are being implemented in education and research programs throughout the country. Federal and state efforts to protect groundwater are resulting in revised pesticide product label instructions and new use restrictions. Applicators should expect a continued emphasis on protection of water supplies.

The EPA has developed a plan for protecting water resources from pesticides. Step one is to place advisories and restrictions on labels of general-use (unclassified) products. Examples of label restrictions include different rates for different soil types and buffer zones. Step two is to move a product from general-use to restricted-use classification. Step three is to require that the product be used only under the terms and conditions of a State Management Plan (SMP). Step four is cancellation.

As an applicator and landowner, you must adhere to label restrictions and should follow the best management practices in handling pesticides. Particular attention should be given to prevention of spills, backsiphoning, and disposal of pesticides. Applicators can do much to prevent contamination by following label directions and maintaining and calibrating application equipment. In Virginia, it is against the law to use equipment in poor repair or to fill tanks directly from a water source without an anti-siphon device in use on the spray equipment.

For more information on anti-siphon devices, sometimes referred to as back-flow preventers, contact your local water authority. ***(Note: most check valves do not qualify as "anti-siphon" devices because they do not break the siphon.)***

Endangered Species Pesticide Use Restrictions

Under the authority of the Endangered Species Act and FIFRA, the U.S. Fish and Wildlife Service and the EPA may restrict pesticide use where such use jeopardizes a federally listed threatened or endangered species.

The EPA's Endangered Species Protection Program is designed to protect federally listed endangered and threatened species from exposure to pesticides. The program's goal is to ensure that pesticide use does not adversely affect the survival, reproduction, and/or food supply of listed species.

Please observe pesticide labeling for changes and keep up to date on this topic. Information is available through your local Extension office, the Virginia Department of Agriculture and Consumer Services, and the Virginia Department of Game and Inland Fisheries.

Guidelines for Disposal of Pesticides and Empty Containers

Always dispose of pesticides and empty containers so they pose no hazard to humans or the environment. Follow label directions and consult your local Extension agent if you have questions. The best solution to the problem of what to do with excess pesticide is to avoid having any. Waste minimization strategies include:

- Buy only the amount needed for a year or a growing season.
- Minimize the amount of product kept in storage.

- Calculate how much diluted pesticide you will need for a job, and mix only that amount.
- Apply pesticide with properly calibrated equipment.
- Use all pesticides in accordance with label instructions.
- Purchase pesticide products packaged in such a way as to minimize disposal problems, or packaged in containers that have legal disposal operations available in your area.

The best disposal option for excess usable pesticide is to find a way to apply the material as directed by the label. Please note that the total amount of active ingredient applied to a site, including all previous applications, must not exceed the rate and frequency allowed by the labeling.

Other pesticide waste disposal options include:

- Follow valid label disposal directions.
- Return product to the dealer, formulator, or manufacturer.
- Participate in a federal indemnification program for canceled/suspended products.
- Employ a professional waste-disposal firm.
- Participate in a state or local "clean day," such as the Virginia Pesticide Control Board-sponsored Pesticide Disposal Program.

Pesticide wastes that cannot be disposed of right away should be marked to indicate the contents and then stored safely and correctly until legal disposal is possible.

Federal law (FIFRA) requires pesticide applicators to rinse "empty" pesticide containers before discarding them. Pesticide containers that have been properly rinsed can be handled and disposed of as non-hazardous solid waste. However, the containers of some commonly used pesticides are classified as hazardous waste if not properly rinsed. Proper disposal of hazardous waste is highly regulated. Improper disposal of a hazardous waste can result in high fines and/or criminal penalties.

A "drip-drained" pesticide container contains product. Immediate and proper rinsing generally removes more than 99 percent of container residues. Properly rinsed pesticide containers pose minimal risk to people and their environment.

There are two methods for proper rinsing:

- Triple Rinsing, and
- Pressure Rinsing.

Pesticide containers should be rinsed as soon as they are emptied. So, the time to rinse is during mixing/loading. If containers are rinsed as soon as they are emptied, the rinse water (rinsate) can be added to the spray tank. This avoids the problem of rinsate disposal and makes sure that nothing is wasted. If containers are rinsed immediately, residues do not have time to dry inside. Dried residues are difficult (or impossible!) to remove. Never postpone container rinsing!

Be sure to wear protective clothing when rinsing pesticide containers. See the product label for information on what to wear.

Table 1.3 - Container Disposal Options after Triple Rinsing (or Equivalent)

Container Type	On-Site Disposal Burn	Landfill	Recycle
Plastic Jug or Pail	no[1,2]	yes	yes[3]
Plastic Bag	no[1,2]	yes	yes[3]
Plastic Drum	no[1,2]	yes	yes[3]
Metal Pail	no	yes	yes[3]
Metal Drum	no	yes	yes[3]
Paper Bag	no[1,2]	yes	no

yes = Recommended.

no = Not recommended.

[1] = Residues make this an unsafe practice.

[2] = Not allowed in Virginia

[3] = Prefered disposal method.

This chart was adapted from the **National Agricultural Chemicals Association** booklet: ***Empty Container Disposal,*** #68001. It was updated in 2003 with input from VDACS/OPS and VDEQ. If you have questions about container disposal, contact your regional DEQ Office.

Pesticide Phone Sales – Buyers Beware

Telephone solicitation of pesticides is an annual problem for growers and applicators in Virginia. As a general rule, applicators should be wary about buying pesticide products "sight unseen." Here is a general description of problems often associated with telephone sales offers:

1. The product actually contains a very low percentage of pesticide active ingredient per unit volume. So, it is actually quite expensive to use on a per-area basis.
2. Often, weed control products contain a small proportion of herbicide formulated with diesel fuel or some other petroleum product. These are generally not recommended and not usable in many situations.
3. The product name is similar to the trade name of another well-known pesticide product or sounds like one from a major pesticide manufacturer's line.
4. The solicitor gives an EPA establishment number but not an EPA registration number. In many cases, this is because the product is not registered with EPA.
5. The product is not registered with VDACS, despite being offered for sale in the commonwealth. This is an illegal practice.

If the potential buyer wishes to follow up on a telephone sales solicitation, he/she should ask for the following information: company name, address, and telephone number; name of salesperson; product name; product registration number; percent active ingredient(s) per unit volume; use site(s); and use rate(s). It is wise to ask for a copy of the label and product MSDS before making a commitment to purchase. If a telephone salesperson does not provide the information you request, the "bargain" is better passed by.

Information given over the telephone can be verified, and the claims for the product can be compared to industry standards or known performance data for the product's active ingredient(s). To check federal and state product registrations, call:

VDACS/Office of Pesticide Services (804) 371-6558 or VCE/Virginia Tech Pesticide Programs (540) 231-6543

If you receive what you suspect to be an improper sales offer, you're encouraged to get as much information as possible and make a complaint to VDACS Office of Pesticide Services by calling (804) 371-6558.

Based on the difficulties associated with telephone solicitations, pesticide users are advised to buy from established dealers and from sellers they know.

Pesticide Use Precautions

Efficient and economical control of insects, plant diseases, and weeds is a factor in the production of all crops. Both management costs and losses resulting from inadequate control can reach tremendous proportions. The use of today's pesticides requires a great degree of precision. In some instances, rates are given in ounces per acre. This requires that pesticide users know how to calibrate equipment and follow detailed directions on product labels.

All pesticides should be used with care. The following suggestions will help minimize the likelihood of injury (from exposure to such chemicals) to people, animals, and non-target plants and animals.

Read the Label - Before buying and applying pesticides, always read all label directions. Follow them exactly when you handle and apply the product. Notice warnings and cautions before opening the container. Repeat the process every time, no matter how often you use a pesticide. The label directions for pesticides often change. Apply materials only on crops specified, at the rate(s) and times indicated on the product label.

Store Pesticides Wisely - A suitable storage site for pesticides protects:

• People and animals from accidental exposure.

• The environment from accidental contamination.

• Stored products from damage (from temperature extremes and excess moisture).

• The pesticides from theft, vandalism, and unauthorized use.

All pesticides should be stored under lock and key, outside the home. Storage facilities should be well-ventilated and well-lit. Pesticide storage areas should be located away from water sources such as ponds or wells. However, a supply of clean water for decontamination is recommended. Non-porous materials are recommended for flooring and shelving. It is important to arrange materials in the storage site so cross-contamination does not occur. Do not store pesticides with food, feed, seed, or fertilizer. An emergency plan should be worked out with local authorities, notifying them of the contents of pesticide storage facilities. If susbstantial quantities of highly toxic pesticides are stored, you must notify (according to law) your local Emergency Response Council. Proper records should be maintained to provide an up-to-date list of contents at all times. Always store pesticides in their original containers and keep them tightly closed. Never keep pesticides in unmarked containers.

Avoid Physical Contact with Pesticides - Never smoke, eat, chew tobacco, or use snuff while handling or applying pesticides. Use the protective clothing and equipment the label requires. Protect your eyes from pesticides at all times. Avoid inhaling sprays or dusts. Do not spill pesticides on skin or clothing. If they are accidentally spilled, remove contaminated clothing immediately and wash exposed skin thoroughly. Wash hands and face and change to clean clothing after applying pesticides. Wash protective clothing, separate from the family laundry, each day, before re-use. Do not spray with leaking hoses or connections. Do not use the mouth to siphon liquids from containers or to blow out clogged lines, nozzles, etc. **See a doctor if symptoms of illness occur during or after the use of pesticides.** A list of Poison Control Centers located in and around Virginia is included in this guide.

Apply Pesticides Carefully: Successful pest control requires application of the correct amount of pesticide uniformly over a targeted area. Pesticide application is a precise operation requiring reliable, properly calibrated equipment. For example, many herbicides have narrow ranges of selectivity. At the suggested rates of application, they will generally control weeds without damaging the crop, but at a slightly higher rate they may damage or kill the crop.

Dispose of Pesticides Correctly: All pesticides should be disposed of according to container directions. All empty containers should be triple rinsed (or equivalent), crushed, and disposed of as directed by the product label. Rinsate should be placed in the spray tank at the time of mixing. Leftover diluted pesticides should be used according to label directions. Leftover concentrates should be disposed of according to EPA guidelines only after exhausting other options. Amounts of chemicals that do not qualify for disposal under these guidelines must be disposed of by an approved hazardous-waste handler.

Protect Pets, Fish, and Wildlife: To protect fish and other wildlife, do not apply pesticides to streams or areas where drainage may be expected to enter waterways unless the product is labeled for use in such areas. Incorporate all granular pesticides into the soil to prevent birds and other animals from eating particles. Scout fields for dead animals and birds before and after application. Remove any carcasses to prevent poisoning of birds-of-prey and scavengers. Report any wildlife poisonings to the Virginia Department of Game and Inland Fisheries. Be aware of bee cautions; see section to follow on protecting honeybees from pesticides.

Cover food and water containers when treating around livestock or pet areas. Do not discard leftover materials into drainage channels. Confine chemicals to the property and crop being treated.

Prevent Drift: Drift can be a problem with any pesticide. However, herbicide drift is the most commonly encountered cause of pesticide damage to susceptible crops. No pesticide can be applied by either aerial or ground equipment without some drift. Spray drift is influenced by air movement, droplet size, and distance traveled by spray before reaching the target area.

To minimize particle drift, application should be made as close to the ground as possible using spray nozzles which eliminate fine droplets. In some instances, spray additives or thickeners may be used to reduce drift.

Some herbicides, such as highly volatile esters of 2,4-D (e.g., isopropyl and butyl esters), are capable of causing injury to adjacent crops by movement in the vapor phase after the spray has dried on the plant or soil surfaces. Use the amine, low-volatility ester or oil-soluble amine formulations to reduce the possibility of vapor drift.

The farmer and the applicator are liable for damages caused by particle drift or volatility.

Select Pesticide Products Wisely: Two or more pesticides may be equally effective in a given situation. Also, the same active ingredient may be available in a variety of formulations. Your selection of a pesticide and its formulation will be determined by the:

1. Site/crop to be treated.
2. Pest species involved.
3. Product availability.
4. Equipment availability.
5. Hazards to humans, domestic animals, wildlife, and desirable plants.
6. Time of application.
7. Relative total costs of materials and application.

All recommended rates of application are based on the amount of active ingredient in a given product. Many commercial products vary in the percentage of active ingredient. The label will give the exact amount of active ingredient in the container and the amount of product to be used in a given area.

To make an accurate cost comparison, it is wise to calculate the cost per area. In general, concentrated products are more economical. However, they may require more handling (measuring, mixing, and loading) than ready-to-use products.

Poisonings

The procedure to be followed ***in case of suspected poisoning****:*

(1) Call a physician immediately. If the family physician is not available, the patient should be taken to the nearest hospital emergency room together with the container of the poisoning agent.

(2) If necessary, the attending physician will call the nearest poison control center for further information on toxicity of the suspected agent, treatment, and prognosis.

(3) You may call a poison control center for information.

NOTE: This information is correct to the best of our knowledge. Listings below were checked for this revision. Please note that this information is subject to change and you should confirm any of these locations and phone numbers now rather than at the time of a poisoning incident.

Poison Information and Treatment Resources For Virginians

National Poison Control Center

Toll-Free Number for all U.S.: (800) 222-1222

Calls to this number will be routed to the closest Regional/Area Poison Control Center.

Website for the American Association of Poison Control Centers is: *www.aapcc.org/*

Regional Poison Control Center

Provides 24-hour information and consultation services by Poison Information Specialists and board-certified Medical Toxicologists. Located in a hospital equipped for all toxicologic (poison) emergencies.

CHARLOTTESVILLE, VA.
Blue Ridge Poison Center
University of Virginia Health Systems
Box 800774
Charlottesville, VA 22908-0774
(434) 924-0347 or (434) 982-3158
www.healthsystem.virginia.edu/internet/brpc/

Area Poison Control Centers

Hospitals with staff who will provide poison information by telephone. Hospitals equipped for most toxicologic emergencies.

WASHINGTON, D.C.
National Capital Poison Center
George Washington University Hospital
3201 New Mexico Ave., NW, Suite 310
Washington, DC 20016
(202) 362-3867
(Calls from D.C. and metropolitan area only)
www.poison.org/

CHARLESTON, W.V.
West Virginia Poison Center
3110 MacCorkle Ave., SE
Charleston, WV 25304
(304) 347-1212
www.wvpoisoncenter.org/

RICHMOND, VA.
The Virginia Poison Center
Virginia Commonwealth UniversityMedical College of Virginia Hospital
1250 East Marshall Street
PO Box 980522 - Richmond, VA - 23298-0522
(804) 828-4780
(Calls from Central and Eastern Va. only)
www.vapoison.org

A complete list of Poison Control Centers is available on the World Wide Web at *www.aapcc.org/*

Pesticide Information Directory

This directory is intended for use by persons who need assistance with general and emergency pesticide-related information. We hope that it will save time and money by directing you to the proper government and industry sources.

The pages that follow include **Emergency Information, General Information, and Industry Associations**. In the blank lines provided, please take time to list your local phone numbers for these sources. In the case of an emergency, it might save a life, as well as possible added expense and inconvenience. Keep a copy of this guide, with this directory section marked, near your phone and/or in your service vehicle for future reference.

Emergency Information

Poisonings For Treatment:	If poisoned, have someone take you immediately to your nearest emergency room with the label of the container.	
My Nearest Poison Control Center Is Located At:	The blanks below are supplied for recording the name and telephone number of the nearest poison control center. Please refer to the Regional and Area Poison Control Centers listed previously in this section. _____ _____ _____	
Phone number	_____	
Spills accidents and other related emergencies	CHEMTREC (for assistance) Chemical Transportation Emergency Center Industry assistance with clean-up procedures, etc.	(800) 424-9300 *chemtrec.com/*
Accidents or **Incidents** that constitute a threat to any person, public safety and health, or the environment must be reported to:	Virginia Department of Agriculture and Consumer Services Office of Pesticide Services Field Operations	(804) 371-6560
For Assistance with Spills and Emergencies Take time to write your local emergency numbers in the space provided.	State Police	_____
	Fire Department	_____
	Ambulance	_____
	Virginia Department of Emergency Management (VDEM) **Emergency Operations Center** *pio@vdem.state.va.us/* - E-mail monitored during regular business hours. *www.virginiaemergency.com/contact/*	(804) 897-6510 (Mon-Fri) 8:15am-5pm **(804) 674-2400** **(800) 468-8892** 24 hours / day
	Local Emergency Services Coordinator	_____
	Local Emergency Response Council	_____

General Information

General Information about pest identification and management about pesticide safety and use patterns	**Virginia Tech** Your Local Extension Office *www.ext.vt.edu/offices/* Virginia Tech Pesticide Programs (0409) Blacksburg, VA 24061 *www.vtpp.ext.vt.edu/*	_____ (540) 231-6543
Regulatory Information including certificate or license status	**Virginia Dept. of Agriculture and Consumer Services** Office of Pesticide Services 102 Governor Street, P.O. Box 1163 Richmond, VA 23218 *www.vdacs.state.va.us/pesticides/*	(804) 371-6558 (800) 552-9963
Community Right-to-know Compliance Information	**Department Of Environmental Quality**; Air, Waste, and Water Division 629 East Main Street, P.O. Box 10009 Richmond, VA 23240-0009 *www.deq.state.va.us/*	(804) 698-4000 (800) 592-5482
EPA Cooperator for general pesticide information	**National Pesticide Information Center (NPIC)** Ag. Chemistry Extension Oregon State University 333 Weniger Hall, Corvallis, OR 97331-6502 *npic.orst.edu/*	(800) 858-7378 9:30 a.m. - 7:30 p.m. EST, 7 days a week
Citizen's Assistance general consumer-related information and complaints	**Virginia Dept. of Agriculture and Consumer Services** Division of Consumer Protection 1100 Bank Street, P.O. Box 1163 Richmond, VA 23219 *www.vdacs.virginia.gov/consumer/* **U.S. Consumer Product Safety Commission** Washington, DC 20207-0001 *www.cpsc.gov/*	(804) 786-2042 in the Richmond area (800) 552-9963 outside the Richmond area M - F: 8:15 am - 5:00 pm (800) 638-2772 TTY (800) 638-8270
Animal Poisonings Assistance	**Va.-Md. Regional College of Veterinary Medicine** Duck Pond Drive Virginia Tech (0442), Blacksburg, VA 24061 *www.vetmed.vt.edu/* **ASPCA Animal Poison Control Center** $55.00 consultation fee, credit cards accepted University of Illinois at Urbana-Champaign College of Veterinary Medicine 2001 S. Lincoln Ave. Urbana, IL 61802 *www.napcc.aspca.org/*	(540) 231-4621 (hospital) Ask your veterinarian to call on your behalf (888) 426-4435
Rcra & Superfund Industry Assistance Hotline	**EPA - Resource Conservation Recovery Act** (Superfund regulations) *www.epa.gov/rcraonline/*	(800) 438-2474
Toxicology Information	**Virginia Dept. of Health** Bureau of Toxic Substances 109 Governor Street, P.O. Box 2448 Richmond, VA 23218 *www.vdh.state.va.us/*	(804) 864-8182

General Information (cont.)

Epa Safe Drinking Water Hotline	For information on drinking water regulations and pesticides in drinking water. *www.epa.gov/safewater/*	(800) 426-4791 (M-F 9:00 am-5:30 pm ET)
Hazard Communication Compliance Information	**Virginia Dept. of Labor & Industry** 13 South 13th Street Richmond, VA 23219-4101 *www.doli.state.va.us/*	(804) 371-2327 TDD (804) 786-2376

Industry Associations

Croplife America 1156 15th St., N.W., Suite 400 Washington, DC 20005	(202) 296-1585 *www.croplifeamerica.org/*
Southern Crop Production Association P.O. Box 7000, 129 Lee Street Dawson, GA 39842	(229) 995-2125 (800) 644-4276 *www.southcrop.org/*
Virginia Crop Production Association, Inc. (VCPA) 6442 Cross Keys Road Mt. Crawford, VA 22841	(540) 234-9408
Responsible Industry for a Sound Environment (RISE) 1156 15th Street, N.W., Suite 400 Washington, DC 20005	(202) 872-3860 *www.pestfacts.org/*
National Pest Management Association (NPMA) 10460 North Street Fairfax, VA 22030	(703) 352-6762 (800) 678-6722 *www.pestworld.org/*
Virginia Pest Management Association (VPMA) P. O. Box 7161 Fredericksburg, VA 22404-7161	(540) 374-9200 (877) 875-8722 *www.vpmaonline.com/*
Professional Landcare Network (PLANET) 950 Herndon Parkway, Suite 450 Herndon, VA 20170	(800) 395-2522 (703) 736-9666 *www.landcarenetwork.org*
Virginia Turfgrass Council (VTC) P.O. Box 5989 Virginia Beach, VA 23471	(757) 464-1004 *www.vaturf.org/*
Virginia Nursery and Landscape Association 383 Coal Hollow Road Christiansburg, VA 24073-6721	(800) 476-0055 (540) 382-0943 *www.vnla.org/*

This directory neither endorses the groups listed nor intends to exclude those not listed. To be included in future revisions contact P.A. Hipkins, Virginia Tech Pesticide Programs, 305 Sandy Hall, Virginia Tech (0409), Blacksburg, VA 24061, telephone: (540) 231-8957.

Protective Clothing and Equipment

Dermal exposures account for 97 percent of all handler exposures that occur during liquid spray application. Thus, the primary purpose of wearing protective clothing is to prevent pesticides from coming into contact with the skin. Any body covering will provide some protection, because dermal absorption is reduced to some degree by a fabric barrier. Protective clothing may be classified according to the part of the body it protects; i.e., feet (boots and shoes), hands (gloves), eyes (goggles and faceshields), head (hats and hoods), and trunk (jackets, shirts, pants, coveralls, overalls, and raincoats).

Because of its comfort, conventional work clothing is worn most often, although it provides minimal protection during the application of liquid spray. Shirts, pants, and jackets of cotton or denim are not recommended by the National Safety Council or EPA because they provide little protection from accidental spills of concentrated pesticides.

Plastic or rubber protective garments are recommended for use when handling pesticide concentrates and for working in liquid-spray operations, particularly when the spray is heavy. However, wearing rubber garments that encase a large part of the body at temperatures of 80˚ to 100˚ Fahrenheit may result in heat exhaustion or heatstroke.

Lightweight synthetic garments may provide adequate protection from dry pesticides and may be used for spray application when laminated with a plastic coating.

The minimum protective clothing and equipment recommended for use when using the more toxic pesticides includes a jacket with hood, bib overalls, goggles, respirator, and waterproof gloves and boots.

Laundering Information for Pesticide-contaminated Clothing - Before laundering, read the pesticide label. Key words on all pesticide labels identify the toxicity of the product: **DANGER POISON** (highly toxic), **WARNING** (moderately toxic), and **CAUTION** (slightly toxic).

Clothing contaminated with highly toxic and concentrated pesticides must be handled most carefully because pesticides are easily absorbed through skin. ***If clothes are saturated with concentrated pesticides, discard them.*** Clothing contaminated by moderately toxic pesticides do not warrant such drastic measures. Hazards are less pronounced in handling clothing exposed to low-toxicity pesticides.

Cleaning/Laundering Recommendations

1. **Cotton or Denim Fabric** - Wash contaminated clothing separately from the family wash. Pesticide residues are transferred from contaminated clothing to other clothing when they are laundered together.

   Note: Regular laundering will not clean fabric contaminated with highly toxic and/or concentrated pesticide. Clothing saturated with either should be discarded, after slashing/cutting to make the item unusable.

   Pre-treating contaminated clothing before washing will help remove pesticide particles from the fabric. This can be done by:

   1. Pre-soaking in a suitable container prior to washing to dislodge the particles.
   2. Pre-rinsing with agitation in an automatic washing machine.
   3. Spraying/hosing garments outdoors.

   Pretreat soiled areas with heavy-duty liquid detergent or a stain-removal product.

   Clothing worn while using slightly toxic pesticides may be effectively laundered in one machine washing. It is strongly recommended that multiple washings be used on clothing worn while applying more toxic pesticides. Also, multiple wash cycles are recommended for protective clothing treated with starch or water/stain repellents. Always wear waterproof, chemical-resistant gloves when handling contaminated clothing to prevent pesticide absorption into the body.

   Washing in hot water removes more pesticide from clothing than other water temperatures. Avoid cold-water washing. Although cold-water washing might save energy, cold-water temperatures are relatively ineffective in removing pesticides from clothing. Multiple wash cycles also are recommended for protective clothing treated with starch or water/stain repellents.

   Laundry additives, such as bleach or ammonia, do not contribute to the removal of pesticide residues. Either of these additives may be used, if desired, but with caution. Bleach should never be added to or mixed with ammonia, because the two react to form a very toxic chlorine gas. Be careful! Do not mix ammonia and bleach.

   Choose heavy-duty liquid detergent. Heavy-duty detergents are particularly effective in removing oily soils (the kind emulsifiable concentrate formulations make). In addition, their performance is not affected by water hardness. Increasing the amount of detergent used is recommended. For unfinished fabrics, use 1.25 times the amount recommended on the package. If the fabric has been treated with a stain/water repellent finish, use 1.5 times the amount the package directs.

   If several garments are contaminated, wash only one or two garments in a single load. Wash garments contaminated by the same pesticide(s) together. Use a full water level to allow the water to thoroughly flush the fabric.

   During seasons when pesticides are being used daily, clothing exposed to pesticides should be laundered daily. This is especially true with highly toxic or concentrated pesticides. It is much easier to remove pesticides from clothing by daily laundering than attempting to remove residues that have accumulated over a period of time.

Pesticide carry-over to subsequent laundry loads is possible because the washing machine is likely to retain residues, which are then released in following laundry loads. It is important to rinse the washing machine with an "empty load," using hot water, the same detergent, and machine settings and cycles used for laundering contaminated clothing.

Line drying is recommended for these items. Many pesticides break down when exposed to heat and sunlight. Line drying eliminates the possibility of residues collecting in the dryer.

When dry, use fabric starch on clothing. Pesticide residues cling to starch and will be removed with the starch in the next washing.

2. **Vinyl-coated fabric, neoprene, or rubber** - This type of outer protective clothing should be pan-washed in warm water using a good detergent. Double or triple washing of heavily contaminated outer protective clothing is desirable. Rinse through two water changes and hang up to air dry. Outer protective clothing should be washed after each exposure or use.
3. **Gloves and boots** should be rinsed before taking them off, then pan-washed inside and out using a good detergent with several rinses. Remember, gloves must be clean inside because they will be in contact with your skin. Wash rubber boots the same as gloves.
4. **Respirators** require special care. Wash inside with a cloth, detergent, and warm water. Change filters according to instructions on the original container. Keep the respirator in a plastic bag, original container, or some other suitable container when it is not being used. Keep the respirator properly adjusted to your face. Filters and prefilters should be kept sealed in a plastic bag when not in use.
5. **Goggles** should be washed with a mild detergent so as not to scratch the lens.

Give all of your protective clothing and equipment the best of care. They may save your life.

Chemical Resistance

Many pesticide labels require the use of specific personal protective equipment (PPE) — clothing and devices that protect the body from contact with pesticides or pesticide residues. Some labels call for **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. Please refer to specific product labels for details.

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

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.

Unless the pesticide label directs otherwise, do not use items that are made of — or lined with — absorbent materials such as cotton, leather, or 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.

Look for PPE items whose labels state that the materials have been tested using American Society for Testing Materials (ASTM) test methods for chemical resistance, such as test method F739-91. 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, PPE should have 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.

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

The type of material that is resistant to non-water-based liquid pesticides depends on the contents of the formulation.

Liquid pesticides that are not water-based may be emulsifiable concentrates, ultra-low-volume and low-volume concentrates, flowables, aerosols, dormant oils, and invert emulsions. Common solvents are xylene, fuel oil, petroleum distillates, and alcohol.

Choosing Chemical-Resistant PPE

Materials are not listed on label.

If the pesticide label requires the use of chemical-resistant PPE but does not indicate the types of materials that are resistant to the product, select sturdy barrier-laminate, butyl, or nitrile materials. Then watch for signs that the material is not resistant to the product. If it is not, it 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 and choose another type of material for the task.

Chemical-Resistance Category Listed on Label.

If the pesticide label specifies the PPE materials that **must** be worn when using the product, follow those instructions.

Some labels may list **examples** of PPE materials that are highly resistant to the product. The label may say, for example: "Wear chemical-resistant gloves, such as barrier laminate, butyl, nitrile, or viton." You may choose PPE items made from any of the listed materials.

Pesticide labels sometimes specify a chemical-resistance category (A through H) for PPE to use when working with the product. This allows you to consult an EPA chemical-resistance chart (such as the one below) for PPE material options.

Table 1.4 - EPA Chemical Resistance Category Selection Chart

For use when PPE section on pesticide label lists chemical resistance category

Selection Category Listed On Pesticide Label	Type Of Personal Protective Material							
	Barrier Laminate ≥ 14 mils	Butyl Rubber ≥ 14 mils	Nitrile Rubber ≥ 14 mils	Neoprene Rubber ≥ 14 mils	Natural Rubber[1]	Polyethylene	Polyvinyl Chloride (PVC) ≥ 14 mils	Viton ≥ 14 mils
A (dry and water-based formulations)	high	high	high	high	high	high	high	high
B	high	high	slight	slight	none	slight	slight	slight
C	high	high	high	high	moderate	moderate	high	high
D	high	high	moderate	moderate	none	none	none	slight
E	high	slight	high	high	slight	none	moderate	high
F	high	high	high	moderate	slight	none	slight	high
G	high	slight	slight	slight	none	none	none	high
H	high	slight	slight	slight	none	none	none	high

[1]Includes natural rubber blends and laminates

HIGH: Highly chemical resistant. Clean or replace PPE at end of each day's work period. Rinse off pesticides at rest breaks.
MODERATE: Moderately chemical resistant. Clean or replace PPE within an hour or two of contact.
SLIGHT: Slightly chemical resistant. Clean or replace PPE within ten minutes of contact.
NONE: No chemical resistance. Do not wear this type of material as PPE when contact is possible.

Using the Chemical-Resistance Category Selection Chart

When pesticide labels list a chemical-resistance category, you can find that category on an EPA chemical-resistance category selection chart. Such a chart will allow you to determine the entire range of PPE materials from which you can choose. The chart indicates how long you can expect the various types of PPE materials to be resistant to the type of pesticide you are using.

Failure to replace or clean the PPE items within the time intervals specified on the chart would be considered a misuse of the pesticide, because the items would no longer meet the label's requirements for "chemical resistant" PPE.

When choosing an appropriate material, also consider the dexterity needed for the task and whether the material will withstand the physical demands of the task. The PPE will protect you for the approximate time listed on the chart, if:

- no punctures, tears, or abrasions allow pesticide to penetrate the material, and
- pesticide does not get inside the PPE through careless practices, such as allowing pesticide to run into gloves or footwear or putting the PPE on over already-contaminated hands or feet.

Highly Resistant PPE

A rating of **high** means that the material is highly resistant to pesticides in that category. PPE made of this type of material can be expected to protect you for an 8-hour work period. The outside of the PPE, especially gloves, should be washed at rest breaks — about once every 4 hours. Highly resistant PPE is a good choice when handling pesticides, especially concentrates, for long periods of time.

Moderately Resistant PPE

A rating of **moderate** means that the material is moderately resistant to pesticides in that category. PPE made of this type of material can be expected to protect you for 1 or 2 hours. After that, replace the PPE with clean chemical-resistant PPE or thoroughly wash the outside of the PPE with soap and water. Moderately resistant PPE may be a good choice for pesticide handling tasks that last only a couple of hours.

Slightly Resistant PPE

A rating of **slight** means that the material is only slightly resistant to pesticides in that category. PPE made of this type of material can be expected to protect you for only a few minutes after exposure to the pesticide product. After that, replace the PPE or thoroughly wash the outside of the PPE with soap and water. Slightly resistant PPE may be a good choice for pesticide handling tasks that last only a few minutes.

Inexpensive disposable gloves or shoe covers, such as those made from polyethylene, may be useful for such brief tasks as:

- Adjusting contaminated parts of equipment.
- Unclogging or adjusting nozzles.
- Opening pesticide containers.
- Moving open pesticide containers or containers with pesticides on the outside.
- Handling heavily contaminated PPE.
- Climbing in and out of cabs or cockpits where the outside of the equipment is contaminated.
- Operating closed systems.

These disposable PPE items should be used only once, for a very short-term task, and then discarded. At the end of the task, it is a good idea to first wash the outside of the gloves or shoe covers and then remove them by turning them inside out. Discard them so they cannot be reused.

(The information about chemical-resistant PPE and the EPA Chemical-Resistant Category Chart was obtained from the EPA/USDA brochure "Choosing Chemical-Resistant PPE," 1993.)

Table 1.5 - Tables of Weights, Measures, and Dilutions

Weights:
28.35 grams = 1 ounce
16 ounces = 1 pound = 453.6 grams
1 pint of water = 1.04 pounds
1 gallon of water = 8.34 pounds
1000 micrograms = 1 milligram
1000 milligrams = 1 gram = 0.035 ounce avoirdupois
1000 grams = 1 kilogram = 2.2 pounds

Volume And Liquid Measure:
3 teaspoons = 1 tablespoon = 14.8 cubic centimeters (cc)
2 tablespoons = 1 fluid ounce = 29.6 cc
8 fluid ounces = 16 tablespoons = 1 cup = 236.6 cc = 1/2 pint
2 cups = 32 tablespoons = 1 pint = 473.1 cc = 16 fluid ounces
2 pints = 64 tablespoons = 1 quart = 946.2 cc = 0.946 liter
4 quarts = 256 tablespoons = 1 gallon = 3785 cc
1 gallon = 128 fluid ounces = 231 cubic inches = 3785 cc
1 milliliter (ml) = 1 cubic centimeter = 0.034 fluid ounces
1000 milliliters = 1 liter = approximately 1 quart, 1 fluid ounce
1 liter of water = 1 kilogram
1 bushel soil = 1.25 cubic feet

Land Measure:
43,560 square feet = 1 acre = 0.404 hectare
1 mile = 5280 feet = 1609.35 meters
10 millimeters = 1 centimeter = 0.3937 inches
100 centimeters = 1 meter = 39.37 inches

Length Of Row Required For One Acre:

Row Spacing	*Length or Distance*
24 inch	7260 yards = 21,780 feet
30 inch	5808 yards = 17,424 feet
36 inch	4840 yards = 14,520 feet
40 inch	4356 yards = 13,069 feet
42 inch	4149 yards = 12,446 feet
48 inch	3630 yards = 10,890 feet

Dilutions:

1 part per million (ppm)	= 1 milligram per liter
	= 1 milligram per kilogram
	= 0.0001 percent
	= 0.013 ounce by weight in 100 gal
1 percent	= 10,000 parts per million
	= 10 grams per liter
	= 1.29 ounces by weight per gallon
	= 8 pounds per 100 gallons

Abbreviations For Pesticide Formulations:

A	=	Aerosol	M	=	Microencapsulated
B	=	Bait	MTF	=	Multiple Temperature Formulation
C	=	Concentrate	P	=	Pellets
CM	=	Concentrate Mixture	RTU	=	Ready to Use
CG	=	Concentrate Granules	S	=	Solution
D	=	Dust	SD	=	Soluble Dust
DF	=	Dry Flowable	SG	=	Soluble Granules
DS	=	Soluble Dust	SP	=	Soluble Powder
E or EC	=	Emulsifiable Concentrate	ULV	=	Ultra Low Volume
ES	=	Emulsifiable Suspension	F	=	Flowable
W or WP	=	Wettable Powder	G	=	Granules
WS	=	Water Soluble	H/A	=	Harvest Aid
WSG	=	Water Soluble Granules	IE	=	Invert Emulsion
WSL	=	Water Soluble Liquid	L	=	Flowable (liquid)
WDG	=	Water Dispersible Granules	LC	=	Liquid Concentrate
WSP	=	Water Soluble Powder			

Temperature:
To change temperature in degrees Celsius to temperature in degrees Fahrenheit, multiply Celsius by 9/5 and add 32.
Example: 30 degrees Celsius = 30 x 9/5 + 32 = 86 degrees Fahrenheit.

Calibration Tables And Information

Table 1.6 - Travel Speed Chart

Time Required in Seconds to Travel			
Miles per Hour	**100 ft**	**200 ft**	**300 ft**
1	68	136	205
2	34	68	102
3	23	46	68
4	17	34	51
5	14	27	41
6	11	23	34
7	10	20	29
8	9	17	26
9	8	15	23
10	7	14	21

1 mph = 88 feet per minute
1 mph = 1.466 feet per second
Speed in mph = Number of 35-inch steps per minute/30

Table 1.7 - Equivalent Quantities of Dry Materials (Wettable Powders) for Various Quantities of Water

Water	Quantity of Material					
100.0 gal[1]	1.0 lb	2.0 lb	3.0 lb	4.0 lb[1]	5.0 lb	6.0 lb
50.0 gal	8.0 oz	1.0 lb	1.5 lb	2.0 lb	2.5 lb	3.0 lb
5.0 gal[1]	0.8 oz (3.0 tbsp)[2]	1.6 oz	2.4 oz	3.2 oz[1]	4.0 oz	4.8 oz
1.0 gal	0.16 oz (2.0 tsp)[2]	0.32 oz (1.0 tbsp)[2]	0.48 oz (1.5 tbsp)[2]	0.64 oz (2.0 tbsp)[2]	0.8 oz (3.0 tbsp)[2]	0.96 oz (3.0 tbsp)[2]

[1]Example: If a recommendation calls for a mixture of 4 pounds of wettable powder to 100 gallons of water, it would take 3.25 ounces to 5 gallons of water to give 5 gallons of spray mixture of approximately the same strength.

[2]Note: Wettable pesticide materials vary considerably in density. Therefore the teaspoonful (tsp) and tablespoonful (tbsp) measurements in this table are approximate but not exact dosages by weight. However, we believe that they are within the bounds of safety and efficacy for mixing small amounts of spray.

Table 1.8 - Equivalent Quantities of Liquid Materials (Emulsifiable Concentrates, Etc.) for Various Quantities of Water

Water	Quantity of Material					
100.0 gal[1]	0.5 pt	1.0 pt	2.0 pt	3.0 pt	4.0 pt[1]	5.0 pt
50.0 gal	4.0 fl oz	8.0 fl oz	1.0 pt	24.0 fl oz	1.0 qt	2.5 pt
5.0 gal	0.4 fl oz (1.0 tbsp)[2]	0.8 fl oz	1.6 fl oz	2.4 fl oz	3.2.0 fl oz	4.0 fl oz
1.0 gal[1]	0.08 fl oz (0.5 tsp)[2]	0.16 fl oz (1.0 tsp)[2]	0.32 fl oz (2.0 tsp)[2]	0.48 fl oz (3.0 tsp)[2]	0.64 fl oz[1] (4.0 tsp)[2]	0.8 fl oz (5.0 tsp)[2]

[1]Example: If 4 pints of a liquid concentrate is recommended to 100 gallons of water, 4 teaspoonsful of the chemical to 1 gallon of water will give a mixture of approximately the same strength.

[2]Approximate figure.

Table 1.9 - Pounds of Active Ingredients per Gallon, Pounds per Pint of Liquid, and the Number of Pints for Various per Acre Rates

Pounds of Active ingredients in one gallon of commercial product	Pounds of active ingredients per pint[1]	Pints of commercial product needed each acre to give the following pounds of active ingredient					
		0.25 lb/A	0.50 lb/A	0.75 lb/A	1.0 lb/A	1.50 lb/A	2.0 lb/A
2.00	0.25	1.00	2.00	3.00	4.00	6.00	8.00
2.64	0.33	0.75	1.50	2.25	3.00	4.50	6.00
3.00	0.375	0.67	1.33	2.00	2.67	4.00	5.33
3.34	0.42	0.60	1.20	1.80	2.40	3.60	4.80
4.00	0.50	0.50	1.00	1.50	2.00	3.00	4.00
6.00	0.75	0.33	0.67	1.00	1.33	2.00	2.67

[1]1 pint = 16 liquid ounces.

Table 1.10 - Available Commercial Materials in Pounds Active Ingredients per Gallon Necessary to Make Various Percentage Concentrate Solutions

Pounds of active ingredients in one gallon of commercial product	Pounds of active ingredients per pint[1]	Liquid ounces of commercial product per one gallon of solution to make:				
		1/2%	1%	2%	5%	10%
2.00	0.25	2.68	5.36	10.72	26.80	53.60
2.64	0.33	2.02	4.05	8.10	20.25	40.44
3.00	0.375	1.78	3.56	7.12	17.80	35.58
3.34	0.42	1.59	3.18	6.36	15.90	31.96
4.00	0.50	1.34	2.67	5.33	13.34	26.69
6.00	0.75	0.89	1.78	3.56	8.90	17.79

[1]Based on 8.34 pounds per gallon (weight of water).

Table 1.11 - Converting Pounds Active Ingredients per Acre to Smaller Units for Small Plots

Liquid

Cubic centimeters per 100 square feet necessary to apply the following pounds of active ingredients per acre

	Concentrate lbs/A															
lbs/gal	**1/8**	**1/4**	**1/2**	**3/4**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
8.00	0.14	0.27	0.54	0.81	1.08	2.16	3.24	4.32	5.40	6.48	7.56	8.64	9.72	10.80	11.88	12.96
7.00	0.16	0.31	0.62	0.93	1.24	2.48	3.72	4.96	6.20	7.44	8.68	9.92	11.16	12.40	13.64	14.88
6.66	0.16	0.33	0.65	0.99	1.30	2.60	3.91	5.21	6.51	7.80	9.10	10.40	11.70	13.03	14.30	15.60
6.00	0.18	0.36	0.72	1.10	1.45	2.89	4.34	5.78	7.23	8.70	10.15	11.60	13.05	14.46	15.95	17.40
5.00	0.22	0.44	0.87	1.31	1.74	3.47	5.21	6.94	8.68	10.44	12.18	13.92	15.66	17.35	19.14	20.88
4.00	0.27	0.54	1.09	1.64	2.17	4.34	6.51	8.68	10.85	13.02	15.19	17.36	19.53	21.69	23.87	26.04
3.33	0.33	0.65	1.31	1.97	2.61	5.21	7.82	10.42	13.03	15.66	18.27	20.88	23.49	26.06	28.71	31.32
3.00	0.36	0.72	1.45	2.16	2.89	5.78	8.67	11.56	14.45	17.34	20.23	23.12	26.01	28.90	31.79	34.68
2.50	0.43	0.87	1.74	2.61	3.47	6.94	10.41	13.88	17.36	20.82	24.29	27.76	31.12	34.71	38.17	41.64
2.00	0.54	1.09	2.17	3.25	4.34	8.68	13.01	17.35	21.69	26.04	30.38	34.72	39.06	43.38	47.74	52.08
1.00	1.08	2.17	4.34	6.51	8.68	17.35	26.03	34.71	43.39	52.08	60.76	69.44	78.12	86.76	95.48	104.16

Dry

Grams per 100 square feet necessary to apply the following pounds of active ingredient per acre

% Active ingredients	lbs										
	1/2	**3/4**	**1**	**2**	**3**	**4**	**5**	**7.5**	**10**	**20**	**50**
100.0	0.52	0.78	1.04	2.08	3.12	4.15	5.19	7.79	10.39	20.77	51.94
90.0	0.58	0.87	1.15	2.31	3.46	4.62	5.77	8.66	11.54	23.08	57.71
80.0	0.65	0.97	1.30	2.60	3.90	5.19	6.49	9.74	12.98	25.97	64.92
75.0	0.69	1.04	1.38	2.77	4.15	5.54	6.92	10.39	13.85	27.70	69.25
50.0	1.04	1.56	2.08	4.15	6.23	8.31	10.39	15.58	20.77	41.55	103.87
25.0	2.08	3.12	4.15	8.31	12.46	16.62	20.77	31.16	41.55	83.10	207.75
22.5	2.31	3.46	4.62	9.23	13.85	18.46	23.08	34.62	46.17	92.33	230.83
20.0	2.60	3.90	5.19	10.39	15.58	20.77	25.97	36.37	51.94	103.87	259.69
18.5	2.81	4.21	5.61	11.23	16.84	22.46	28.07	42.11	56.15	112.30	280.74
12.5	4.15	6.23	8.31	16.62	24.93	33.24	41.55	62.32	83.10	166.20	415.50
10.0	5.19	7.79	10.39	20.77	31.16	41.55	51.94	77.91	103.87	207.75	519.37
7.5	6.92	10.39	13.85	27.70	41.55	55.40	69.25	103.87	138.50	277.00	692.50
5.0	10.39	15.58	20.77	41.55	62.32	83.10	103.87	155.81	207.75	415.50	1038.74
4.0	12.98	19.48	25.97	51.94	77.91	103.87	129.84	194.76	259.69	519.37	1298.43
2.0	25.97	38.95	51.94	103.87	155.81	207.75	259.69	389.53	519.37	1038.74	2596.86
1.0	51.94	77.91	103.87	207.75	311.62	415.50	519.37	779.06	1038.74	2077.49	5193.72

Table 1.12 - Determination of Product Rate per Acre from Active Ingredient Rate

(Liquid Formulations)

Active Ingredient per gallon					
Active Rate lb/A	**1.5 lb**	**2.0 lb**	**3.0 lb pt/A**	**4.0 lb**	**6.0 lb**
0.25	1.33	1.0	0.83	0.5	0.33
0.5	2.67	2.0	1.33	1.0	0.67
1.0	5.33	4.0	2.67	2.0	1.33
2.0	10.67	8.0	5.33	4.0	2.67
3.0	16.00	12.0	8.00	6.0	4.00
4.0	21.33	16.0	10.67	8.0	5.50
5.0	27.00	20.0	13.33	10.0	6.67

Table 1.13 - Determination of Product Rate per Acre from Active Ingredient Rate

(Dry Formulations)

Percentage of Active Ingredient in Product										
Active Rate lb/A	**5**	**10**	**20**	**25**	**50**	**65**	**70**	**75**	**80**	**90**
						lb/A				
0.25	5.0	2.5	1.2	1.0	0.5	0.37	0.36	0.32	0.3	0.28
0.5	10.0	5.0	2.5	2.0	1.0	0.75	0.72	0.65	0.6	0.55
1.0	20.0	10.0	5.0	4.0	2.0	1.50	1.40	1.30	1.2	1.10
2.0	40.0	20.0	10.0	8.0	4.0	3.00	2.90	2.60	2.4	2.20
3.0	60.0	30.0	15.0	12.0	6.0	4.50	4.30	3.90	3.6	3.30
4.0	80.0	40.0	20.0	16.0	8.0	6.00	5.80	5.20	4.8	4.40
5.0	100.0	50.0	25.0	20.0	10.0	7.50	7.20	6.50	6.0	5.50

Calibration of Boom Sprayers

Be sure to calibrate your sprayer properly. NEVER exceed the labeled rate. Using too much pesticide is illegal and may injure your crop. Using too little may result in little or no pest control. Pressure, nozzle orifice size, spacing of nozzles, and speed all affect the application rate. Be sure that all of your spray equipment is in good working order and your sprayer is configured properly.

Large-area Method of Calibration

1. Measure and stake off one acre (43,560 sq ft) in the field to be treated.
2. Fill sprayer tank with water.
3. Maintain constant pressure and speed while spraying the acre. Mark pressure, throttle, and gear settings.
4. Measure the amount of water used. The amount of water necessary to refill the tank is equal to gallons per acre applied.
5. Make up the spray solution with the correct amount of chemical, based on the amount of water applied per acre.
6. Make the application at pressure, throttle, and gear settings used in calibrating.

"Ounce" Method

1. Mark off a test course, based on the chart below.
   (Measure nozzle spacing for booms; row spacing for directed and band rigs.)
2. Fill your tank half full (average weight). Set the throttle for spraying. Get a running start. Drive the test course three times while operating the equipment under field conditions. Record driving times (# of seconds) for each trial.
3. Calculate the average time in seconds required to drive the measured distance.
4. Run the equipment for the average time it took to drive the course, using the same settings (RPMs, pressure). Catch output during that time in a container marked in ounces. (If you are using a boom sprayer, catch the output from one nozzle. If you are using a directed/band rig, catch the spray from all nozzles per row for the prescribed time.)
5. Output in ounces = gallons per acre (GPA) applied.

Table 1.14 - "Ounce" Method Distances

Row Width or Nozzle Spacing (inches)	Distance (feet)	Row Width or Nozzle Spacing (inches)	Distance (feet)
48	85	30	136
46	89	28	146
44	93	24	170
42	97	20	204
40	102	18	227
38	107	15	272
36	113	10	408

This method works because the test course is 1/128th of an acre, and an ounce is 1/128th of a gallon — the proportions are the same.

A word of caution: If you use the "ounce" method, your calibration check is based on only one nozzle. Be sure your calibration check is based on the right nozzle (and pressure) for the job — and that the nozzle is in good condition. This method is valid ONLY if the output from each nozzle (or sets of nozzles) is uniform! So, you should check ALL nozzles (or sets of nozzles, in the case of banding/directed applications) to be sure the output from each one (or each set) is the same. You can do this by using a flow meter, or by catching the output from each for a short time (ex. 10 seconds). Replace any nozzles that do not match the pattern and flow rate of the one(s) you used in the calibration test.

For more information and/or for guidance on calibration methods for other types of equipment, contact your local Extension agent.

Chemical Information Chart

This section contains a chart listing commonly used pesticides (chemical name/trade name), their manufacturers, their actions, and their acute toxicity rating (oral LD_{50}). Pesticides which have been canceled are given only as a reference to their toxicity and should not be used.

This list is for information purposes only and was not meant to endorse or exclude any manufacturers or their products. The names are correct to the best of our knowledge. If mistakes were made, they were unintentional. Please notify the authors if corrections or additions are needed for the next edition.

Names

The common chemical name is the approved name given a pesticide by the American National Standards Committee. An active ingredient may have many trade names, given to a pesticide by the manufacturers/producers.

Action

The specific actions of the pesticides listed are abbreviated as follows:

A	- acaricide	IGR	- insect growth regulator
Anti	- antibiotic	M	- molluscicide
Av	- avicide	Mi	- miticide
B	- bactericide	N	- nematicide
F	- fungicide	PGR	- plant growth regulator
Fum	- fumigant	R	- rodenticide
H	- herbicide	Rep	- repellent
H A	- harvest aid (defoliant)	V	- vertebrate control
I	- insecticide		

Toxicity

Toxicity is the quality, state, or degree of being poisonous. The toxicities listed here are oral. Oral LD_{50} (mg/kg) is the dosage in milligrams per kilogram of body weight required to kill 50 percent of test animals when given as a single dose by mouth. A milligram/kilogram (mg/kg) is equal to 1 part per million (1 lb in 500 tons). The lower the LD_{50}, the higher the toxicity. Dermal LD_{50} ratings are in most cases higher (lower in toxicity) than oral ratings.

When registering pesticides, the Environmental Protection Agency (EPA) uses acute LD_{50} values to determine the toxicity category, words, and symbols that must be placed on the label. For this purpose the test animals are usually mice, rats, or rabbits. The letters LD stand for lethal dose.

Table 1.15 - Toxicity Categories

Toxicity Category	Signal Words* Required on Label by EPA	Oral LD_{50} (mg/kg)	Probable Lethal Adult Human Dose
I Highly Toxic	DANGER and POISON, plus skull and crossbones symbol	0 to 50	A few drops to 1 teaspoon
II Moderately Toxic	WARNING	50 to 500	1 teaspoon to 2 teaspoons
III Slightly Toxic	CAUTION	500 to 5,000	1 ounce to 1 pint (1 pound)
IV Almost non-toxic	CAUTION	more than 5,000	1 pint (1 pound)

***Please note:** certain products may use signal words which do not correlate with LD_{50} ratings due to some special property of the chemical. For example, chlorothalonil has a very low toxicity (LD_{50} 10,000 mg/kg) yet has DANGER and WARNING signal words on many of its formulations, due to a possibility of an extreme allergic reaction in some people. Also, toxicity (LD_{50}) is relative to the concentration of active ingredient in question and the body weight of the victim.

All LD_{50} ratings listed here are for technical grade compounds; however, pesticide products are not sold as 100 percent concentrations. To find the LD_{50} for a specific pesticide product – which takes into account the toxicity of the active ingredients, its concentration, and all other components in the formulation – consult the MSDS. Remember that if misused, any pesticide can be highly toxic to humans, domestic animals, and wildlife.

Restricted-Use Pesticides ([1])

Those active ingredients having some or all products designated as **restricted use** are marked with a **superscript one** ([1]) in Table 1.16. Products that are restricted usually have a higher toxicity, concentration, or other property which makes them more hazardous than products which are designated for general use. Refer to the product label as a guide. Applicators must be certified to use or purchase restricted-use pesticides. Contact your local Extension agent for information on how to become a certified applicator.

Table 1.16 - Chemical Information Chart

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
abamectin[1]	Abba, Agri-Mek, Avid, Greyhound, various	I/Mi	Arborsystems, Syngenta	300
acephate	Orthene, Payload, Pinpoint	I	Dow AgroSciences, MicroFlo, Scotts, Valent	866-945
acetamiprid	Assail, Tristar	I	Cerexagri, Cleary	314-417
acetic acid	vinegar	H	various	331
acetochlor[1]	Cadence, Confidence, Degree, Harness, Surpass, Topnotch	H	Dow AgroSciences, Loveland, Monsanto	2,953
acifluorfen	Blazer	H	United Phosphorus	2,025
Agrobacterium radiobacter	Galltrol-A, NoGall	F	Agbiochem, Becker-Underwood	low toxicity
alachlor[1]	Intrro, Lasso, Micro-Tech Partner	H	MicroFlo, Monsanto	~1,000
aldicarb[1]	Temik	I/N	Bayer	0.93
allethrin	various	I	various	680-1,000
aluminum phosphide[1]	Fumitoxin, Gastoxin, Phosfume, Phostoxin, Weevil-Cide	Fum	Bernardo, Degesch, Douglas, Pestcon, United Phosphorus	0.3
ametryn	Evik	H	Syngenta	1,110
aminopyralid	Milestone	H	Dow AgroSciences	> 5,000
amitraz[1]	Ovasyn, Taktic	H	Bayer, Interbet	800
ammonium salts of fatty acids	Hinder, Weed Aside	Rep, H	Amvac, Matson, Necessary, Gardens Alive	50-5,000
ancymidol	A-Rest	PGR	Sepro	4,500
anthraquinone	Avipel, Flight Control	Rep/V	Airepel, Arkion Life Science, Sepro	> 5,000
ASPIRIN				750
asulam	Asulox	H	Bayer	5,000
atrazine[1]	Aatrex	H	Syngenta, various	3,080
avitrol[1]	Avitrol	AV	Avitrol Corp.	20
azadirachtin	Amazin, Aza-Direct, Azatin, Azatrol, Ecozin, Ornazin	IGR, I, F, Rep	Amvac, Certis, Gowan, Olympic, PBI Gordon, Sepro	> 5,000
azinphos-methyl[1]	Guthion	I	Bayer, Gowan, MicroFlo	5-20
azoxystrobin	Abound, Dynasty, Heritage, Quadris	F	Syngenta	> 5,000
Bacillus licheniformis	Ecoguard	F	Novozymes	> 5,000
Bacillus sphaericus	Vectolex	I	Valent	> 5,000
Bacillus subtilis	Companion, Serenade, Rhapsody	F	AgraQuest, Becker-Underwood, Growth Products	low toxicity
Bacillus thuringiensis	DiPel, various	I	various	> 5,000

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
Beauveria bassiana	Botaniguard, Naturalis	I	Emerald Bio, Troy Biosciences	low toxicity
benefin (benfluralin)	Balan, Team	H	Dow AgroSciences, various	> 10,000
benzamide	Recruit, Shatter	I, IGR	Dow AgroSciences	116
bensulide	Prefar	H	Gowan, various	770
bentazon	Basagran, Rezult	H	BASF, various	1,100
bifenazate	Acramite, Floramite	Mi	Crompton	> 5,000
bifenthrin[1]	Talstar, various	I	FMC, various	54.5
borax	various	I	various	4,500-6,000
Bordeaux Mixture	Copper/Sulfur	F	various	low toxicity
boric acid	various	I	various	low toxicity
brodifacoum[1]	Final, various	R	Bell Labs, various	0.27
bromacil	Hyvar, various	H	DuPont, various	5,200
bromadiolone[1]	Contrac, various	R	Bell Labs, various	0.56-0.84
bromethalin	Assault, Fastrac, various	R	Bell Labs, various	2.0
bromoxynil	Buctril, various	H	Bayer	190
buprofezin	Applaud, Talus, various	IGR	Nichino, Sepro	180-400
butralin	Butralin, Stifle	H, PGR	Crompton	890-1,540
butylate	Butan, Sutan	H	HelmAgro	4659
capsaicin	Hot Sauce, various	Rep	various	low toxicity
captan	Captan, various	F	various	9,000
carbaryl	Sevin, various	I/Mi	various	850
carbofuran[1]	Furandan	I/N	FMC	11
carboxin	Vitavax	F	various	3,820
carfentrazone-ethyl	Aim	H	FMC	> 5,000
chlorethoxyfos[1]	Fortress	I/Mi	Amvac	1.8-4.8
chlorfenapyr	Phantom, Pylon	I/Mi	BASF, OHP	441
chlorimuron ethyl	Classic, Skirmish	H	Dupont, FMC	4,102
chloroneb	Catapult, Teremec	F	Agriliance, PBI Gordon	> 5,000
chlorophacinone[1]	Rozol	R	Liphatech	3.15
chloropicrin[1]	Chlor-O-Pic	Fum	Great Lakes	250
chlorothalonil	Bravo, Chloronil, various	F	Syngenta, various	> 10,000
chlorpropham	Decco	H, PGR	Cerexagri	3,800
chlorpyrifos[1]	Dursban, Lorsban	I	Dow AgroSciences, various	135-163
chlorsulfuron	Telar	H	DuPont	5,545
chlorthal-dimethyl	Dacthal	H	Amvac	3,000
clethodim	Arrow, Envoy, Select, Volunteer	H	Valent, various	1,630
clofencet[1]	Genesis	H/PGR	Monsanto	3,306
clofentezine[1]	Apollo, Ovation	Mi	Makhteshim-Agan, Scotts-Sierra	> 5,200
clomazone	Command	H	FMC	2,077

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats- Oral (mg/kg) Technical
clopyralid	Lontrel	H	Dow AgroSciences	> 4,300
cloransulam-methyl	Amplify, FirstRate	H	Dow AgroSciences, Monsanto	> 5,000
clothianidin	Arena, Belay, Celero, Clutch, Poncho	I	Arysta, BASF	> 5,000
copper chelate	Cutrine, various	H(aq)	Applied Biochemists, PBI Gordon	0.50-2.00
copper hydroxide	Kocide, various	H(aq)	Griffin	1,000
copper sulfate	Bluestone, various	H(aq)	various	470
coumaphos[1]	Co-Ral	I/A	Bayer	56-230
m-cresol	Gallex	F	Agbiochem	242
creosote[1]	coal tar	F/I	Koppers	high toxicity
cryolite	Kryocide, Prokil	I	Cerexagri, Gowan	> 10,000
cycloate	Ro-Neet	H	HelmAgro	2,000-3,190
cyfluthrin[1]	Baythroid, Tempo	I	Bayer	400
(gamma-) cyhalothrin[1]	Proaxis, Prolex	I	Helena	50
(lambda-) cyhalothrin[1]	Demand, Karate, Warrior	I	Syngenta	79
cymoxanil	Curzate, Tanos	F	DuPont	1,100
cypermethrin[1]	Ammo, Demon, Prevail	I	various	250-4,150
cyprodinil	Vangard	F	Syngenta	> 2,000
cyromazine	Citation, Trigard	IGR	Syngenta	3,387
2,4-D	various	H/PGR	various	300-700
2,4-DB	various	H	various	370-1,500
DCPA	see chlorthal	—	—	—
DDT	various	I	—	113
daminozide	B-Nine	PGR	Crompton	8,400
dazomet	Basamid, various	Fum	BASF, various	520
decanol	royaltac, various	PGR	Crompton, various	18,000
deet	OFF, various	Rep	SC Johnson, various	8,500
deltamethrin[1]	Decis, various	I/Mi	Bayer, various	> 5,000
desmedipham	Alphanex	H	United Phosphorus	> 10,000
diazinon[1]	Diazion	I	various	300-4
dicamba	Banvel, Vanquish, various	H	BASF, Syngenta, various	1,707-6,764
dichlobenil	Casoron	H	Crompton	> 3,160
1,3-dichloropropene[1]	Telone	Fum	Dow AgroSciences	250-500
dichlorvos	Vapona, various	I	various	56-80
diclofop-methyl[1]	Hoelon, Illoxan	H	Bayer	563
dicloran	Allisan, Botran	F	Gowan	> 5,000
dicofol	kelthane	A	Dow AgroSciences	595
dicrotophos[1]	Bidrin, Inject	I	Amvac, Mauget	22
difenoconazole	Dividend	F	Syngenta	1,453
diflubenzuron[1]	dimilin	IGR	Crompton	> 4,640

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
diflufenzopyr-sodium	—	H	BASF	> 5,000
dikegulac sodium	Atrimmec, Pinscher	PGR	Arbor Systems, PBI Gordon	18,000-31,000
dimethenamid	Frontier	H	BASF	2,400
dimethipin	Harvade	PGR	Crompton	1,180
dimethoate	Cygon, Dimethoate	I	various	290-325
dimethomorph	Acrobat, Forum, Stature	F	BASF, Sepro	3,900
diphacinone[1]	Ditrac	R	Bell Labs	3
diquat dibromide	Enforcer, Weedtrine-D	H	various	231
disulfoton[1]	Di-Syston	I	various	2-12
dithiopyr	Dimension	H	Dow AgroSciences, various	3,600
diuron	Ginstar, Karmex, Topsite	H	BASF, various	3,400
dodecenyl acetate	GBM Sprayable	IGR	3-M	> 5,000
dried blood	Shot-gun, Rabbit-Ridder	Rep	Bonide, Ferti-Lome	low toxicity
DSMA	DSMA	H	various	1,935
egg solids	Deer-Away, Deer-Off	Rep	Woodstream, various	34,600
emamectin[1]	Denim, Proclaim	I	Syngenta	76-89
endosulfan	Thiodan	I	various	40
endothall	Accelerate, Aquathol	H/H(aq)	Cerexagri	51
EPTC	Eptam	H	Syngenta	1,630
esfenvalerate[1]	Asana	I	DuPont	75-458
ethalfluralin	Sonalan	H	Dow AgroSciences	> 10,000
ethephon	Cerone, Ethrel, Florel	PGR	Bayer, various	4,000
ethofumesate	Progress	H	Bayer	6,400
ethoprop (ethoprophos)[1]	Mocap	I/N	Bayer	62
ethylene oxide	Oxyfume	Fum	Honeywell	50 (vapor)
etoxazole	Tetrasan, Zeal	A, I, IGR, Mi	Valent	> 5,000
etridiazole	Banrot, Terrazole, Truban	F	Crompton, Scotts-Sierra	1,077
fatty acid salts	Hinder, M-Pede, “soaps”	I/Mi, H, Rep	various	> 5,000
fenarimol	Rubigan	F	Dow AgroSciences	2,500
fenbuconazole	Indar	F	Dow AgroSciences	> 2,000
fenbutatin-oxide (hexakis)[1]	Vendex	A	Griffin	2,630
fenhexamid	Elevate	F	Arvesta	> 2,000
fenoxaprop-ethyl	Acclaim	H	Bayer	4,670
fenoxycarb	Award, Logic, Precision	IGR	Syngenta	> 10,000
fenpropathrin[1]	Danitol, Tame	A/I	Valent	70
fenpyroximate	Akari, Fujimite, Portal	I/Mi	Nichino, Sepro	480

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
ferbam	Ferbam	F	Taminco	> 17,000
fipronil[1]	Frontline, Regent, Termidor	I/Mi	Bayer	336
fluazifop-P-butyl	Fusilade	H	Syngenta, various	3,680
fluazinam	Omega	F	Syngenta	> 5,000
fludioxonil	Maxim, Medallion	F	Syngenta	> 5,000
flufenacet	Define	H	Bayer	589-1,617
flumetralin	Prime +	PGR	Syngenta	> 5,000
flumetsulam	Python	H	Dow AgroSciences	> 5,000
flumiclorac-pentyl	Resource	H	Valent	> 5,000
flumioxazin	Broadstar, Gangster, Payload, SureGuard, Valor	H	Valent	> 5,000
fluometuron	Cotoran, Meturon	H	Griffin	6,416-8,900
fluopicolide	Presidio, Stellar	F	Valent	> 5,000
fluridone	Avast, Sonar	H (aq)	Griffin, Sepro	> 10,000
fluroxypyr	Spotlight, Starone, Vista	H	Dow AgroSciences	> 2,405
flurprimidol	Cutless	PGR	Sepro	709-914
flutolanil	Contrast, Monocut, Prostar	F	Bayer, Gowan, Scotts-Sierra	> 10,000
fluvalinate	Apistan, Mavrik	I	Wellmark	260-280
fomesafen	Flexstar, Reflex	H	Syngenta	1,250-2,000
formeldehyde	formalin	B/F	various	550-800
formic acid	For-Mite	Mi	Apicure, Mann Lake Ltd.	110
fosamine ammonium	Krenite	H	DuPont	10,200
fosetyl-Al	Aliette, Signature	F	Bayer	5,800
gibberellic acid	Gib Gro, Pro-Gibb	PGR	various	630
Gliocladium virens	Soil Gard	F	Certis	low toxicity
glufosinate-ammonium	Derringer, Finale, Ignite, Liberty, Remove, Rely	H	Bayer	1,620-2,000
glyphosate	Accord, Rodeo, Roundup	H	Monsanto, various	4,050-5,600
halofenozide	Mach 2	I	Dow AgroSciences	> 5,000
halosulfuron-methyl	Sandea, Sedgehammer	H	Gowan, Monsanto	1,287
harpin protein	Messenger, Proact	B, I, F, N, PGR	Eden Bioscience	low toxicity
hexaflumuron	Recruit, Shatter	I	Dow AgroSciences	> 5,000
hexazinone	Velpar	H	DuPont	1,690
hexythiazox	Hexygon, Savey	Mi	Gowan	> 5,000
hydramethylnon	Amdro, Seige, Subterfuge	I	BASF, various	1,131-1,300
hydroprene	Gentrol, various	IGR	Bayer, S.C. Johnson, Wellmark	> 34,600
IBA	Hormodin, various	PGR	Geiger, MicroFlo, various	100 (mice)
imazalil	Fungaflor	F	Whitmire	227-343
imazamox	Clearmax, Raptor	H	BASF	> 5,000

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
imazapic	Cadre, Plateau	H	BASF	> 5,000
imazapyr	Arsenal, Chopper, Contain, Habitat, Stalker	H	BASF	> 5,000
imazaquin	Image, Scepter	H	BASF	> 5,000
imazethapyr	Pursuit	H	BASF	> 5,000
imidacloprid	Admire, Advantage, Merit, various	I/A	Bayer, Cheminova	450
indoxacarb	Advion, Avaunt, Steward	I	DuPont	268-1,732
iprodione	Rovral	F	Bayer	3,500
isoxaben	Gallery	H	Dow AgroSciences	> 10,000
kinoprene	Enstar	IGR	Wellmark	4,900-5,000
kresoxim-methyl	Cygnus, Sovran	F	BASF	> 5,000
lactofen	Cobra	H	Valent	> 5,000
lime sulfur	lime-sulfur	F	various	820
linuron	Linex, Lorox	H	Griffin	1,500-4,000
magnesium phosphide[1]	Fumi-Cel, Fumi-Strip, Magtoxin	Fum	Degesch	0.3
malathion	Cythion, Fyfanon, Malathion, various	I	various	1,375-2,800
maleic hydrazide	MH-30, various	H/PGR	various	6,950
mancozeb	Dithane, Fore, Manzate, various	F	various	> 5,000
maneb	Maneb, Manex	F	various	> 5,000
MCPA	MCPA	H	various	700-800
mecoprop	MCPP, MecoMec	H	PBI/Gordon, Riverdale, Scott's	930
mefenoxam	see metalaxyl-M	—	—	—
mefluidide	Embark, Sta-Lo	H/PGR	PBI/Gordon, various	> 4,000
mesotrione	Callisto, Tenacity	H	Syngenta	> 5,000
metaflumizone	Siesta	I	BASF	> 5,000
metalaxyl-M (mefenoxam)	Apron, Mefenoxam, Subdue	F	various	1,040
metaldehyde	Deadline, various	M	various	630
metam-sodium[1]	Vapam, various	Fum	Amvac, various	1,800
metconazole	Caramba, Quash, Tourney	F	BASF, Valent	660
methamidophos[1]	Monitor	I	Valent	18-21
methanone	Armor, Disarm, Evito	F	Arysta	—
methanone	Impact	H	Amvac	> 2,000
methidathion[1]	Supracide	I	Gowan	44
methiocarb[1]	Mesurol	I/M/Rep	Gowan	15-35
methomyl[1]	Lannate, Larvin, various	I/N	Bayer, DuPont, various	17-24
methoprene	Altosid, various	IGR	Wellmark Intl., various	34,600
methoxychlor	various	I	various	6,000
methoxyfenozide	Intrepid	I	Dow AgroSciences	> 5,000

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
methyl anthranilate	ReJex-iT	Rep	Becker-Underwood, various	low toxicity
methyl bromide[1]	Bromo-O-Gas, Metabrom, Meth-O-Gas	Fum	Great Lakes, various	200 (vapor)
metiram	Polyram	F	Loveland	> 10,000
metolachlor	Cinch, Dual, Pennant	H	Syngenta, various	2,780
metribuzin	Metribuzin, Sencor, Tricor	H	Bayer, various	1,100-2,300
metsulfuron-methyl	Ally, Escort	H	DuPont, various	> 5,000
mineral oil	Volck Oil Spray, various	I/A	various	low toxicity
MSMA	various	H	various	700
myclobutanil	Eagle, Laredo, Nova, various	F	Dow AgroSciences, various	1,600-2,290
NAA	Dip-N-Grow, RootMaster	PGR	various	1,000
NAD	Amid-Thin, Rootone	PGR	Amvac, Bayer	1,000
naled	Dibrom, Trumpet	I	Amvac	430
naphthalene	“moth balls”	Fum/I/Rep	various	50-500
napropamide	Devrinol	H	United Phosphorus	5,000
naptalam	Alanap	H	Crompton	8,200
neem	see azadirachtin	—	—	—
nicosulfuron	Accent	H	DuPont	> 5,000
nicotine[1]	Fulex, various	I	Fuller System, various	50-60
norflurazon	Predict, Solicam, Zorial	H	Syngenta	> 9,400
novaluron	Diamond, Pedestal, Rimon	I	Crompton	> 5,000
noviflumuron	Recruit	IGR	Dow AgroSciences	> 5,000
oryzalin	Surflan, various	H	United Phosphorus, various	> 10,000
oxadiazon	Ronstar, various	H	Bayer, various	> 8,000
oxamyl[1]	Vydate	I/N	DuPont	5.4
oxydemeton-methyl[1]	MSR	I, Mi	Gowan	65-75
oxyfluorfen	Goal, various	H	Dow AgroSciences, various	> 5,000
paclobutrazol	Bonzi, Cambistat, Piccolo, Profile, Trimmit	PGR	Crompton, Rainbow Treecare, Sepro, Sci Reg, Syngenta	5,346
paradichlorobenzene	“moth balls”	I/Rep	various	500-5,000
paraquat[1]	Gramoxone	H	Syngenta	150
(methyl) parathion[1]	Methyl Parathion, Penncap-M	I	Cerexagri, Cheminova	14-24
pendimethalin	Pendulum, Prowl, various	H	BASF, Scott’s, various	1,250
pentachloronitrobenzene	PNCB, Terraclor	F	Amvac, Crompton	1,650-12,000
permethrin[1]	Ambush, Pounce, various	I	Amvac, FMC, various	4,000
phenimedipham	Spin Aid	H	Bayer	> 4,000
phorate[1]	Thimet	I	BASF, various	2-4
phosmet	Imidan	I	Gowan	147-316

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats-Oral (mg/kg) Technical
phosphine gas[1] (hydrogen phosphide)	Eco 2 Fume, VapoPh30s	I/Mi, Fum	Cytec Ind.	0.3
phostebupirim[1]	Aztec[1] (w/cyfluthrin)	I	Amvac, Bayer	2.9-3.6
picaridin	Cutter, Off	Rep	S.C. Johnson, Spectrum	—
picloram[1]	Tordon K	H	Dow AgroSciences	8,200
pinoxaden	Axial	H	Syngenta	> 5,000
piperalin	Pipron	F	Sepro	2,500
piperonyl butoxide	(used as a synergist)	I	various	> 7,500
pirimiphos-methyl	Actellic	I	Agriliance	> 2,000
potassium bicarbonate	Armicarb, Kaligreen, Milstop, Remedy	F	Agrivert, Helena, Viaworks	500-5,000
primisulfuron-methyl	Beacon	H	Syngenta	5,050
prodiamine	Barricade, Endurance, various	H	Syngenta, various	> 5,000
profenofos[1]	Curacron	I, A	Syngenta	358
prohexadione calcium	Apogee	PGR	BASF	> 5,000
prometon	Pramitol, various	H	various	2,980
prometryn	Caparol, Cotton-Pro, various	H	Syngenta, various	5,235
pronamide[1] (propyzamide)[1]	Break-Up[1], Kerb (Kerb WSP/50WSP only[1])	H	Dow AgroSciences, United Phosphorus	5,620-8,350
propamocarb hydrochloride	Banol, Previcur	F	Bayer, Prokoz	8,600
propargite	Comite, Omite, Ornamite	A	Crompton	2,200
propetamphos[1]	Zoecon	I	Wellmark	119
propiconazole	Alamo, Banner, Orbit, Tilt	F	Syngenta	1,517
propoxur	Baygon, various	I/Mi	Bayer, various	95-104
propyzamide[1]	see pronamide	—	—	—
prosulfuron	Peak	H	Syngenta	4,360
prothioconazole	Proline	F	Bayer	> 6,200
pymetrozine	Endeavor, Fulfill	I	Syngenta	5,820
pyraclostrobin	Cabrio, Headline, Insignia	F	BASF	500-> 2,000
pyrethrum	Pyrethrins	I	various	584-900
pyridaben	Nexter, Sanmite	I/Mi	Gowan	820-1,350
pyrithiobac-sodium	Staple	H	DuPont	4,000
quinclorac	Drive, Paramount	H	BASF	> 2,610
quinoxyfen	Quintec	F	Dow AgroSciences	> 5,000
quizalofop-p-ethyl	Assure II, Targa	H	DuPont, Gowan	1,182-1,210
resmethrin[1]	various	I	Bayer, Bonide, various	> 2,500
rimsulfuron	Matrix, Resolve, Shadeout, Tranxit	H	DuPont	> 5,000
rotenone[1]	various	I	Bonide, Dragon, various	132-1,500
sethoxydim	Poast, Vantage, various	H	BASF	2,676-3,200

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats- Oral (mg/kg) Technical
siduron	Tupersan, various	H	various	> 7,500
silica gel	various	I	various	3,160
simazine	Princep, various	H	Syngenta, various	> 5,000
sodium chlorate	various	H	various	1,200
sodium chloride	TABLE SALT	H	Morton	3,320
sodium cyanide[1]	M-44	V	USDA-APHIS-ADC	6.4
sodium fluoroacetate[1]	1080	V	USDA-APHIS-ADC	0.22
spinetoram	Delegate, Radiant	I	Dow AgroSciences	> 5,000
spinosad	Conserve, SpinTor, Tracer	I/Mi	Dow AgroSciences, various	> 5,000
streptomycin sulfate	Agri-Mycin, various	F	various	> 10,000
sulfentrazone	Authority, Spartan	H	DuPont, FMC	2,855
sulfometuron-methyl	Oust	H	DuPont, various	> 5,000
sulfosulfuron	Certainty, Maverick, Outrider	H	Monsanto	> 5,000
sulfur	Brimstone, Thiolux	F, I/Mi	Syngenta, various	low toxicity
sulfuryl fluoride[1]	Profume, Vikane, Zythor	Fum	Dow AgroSciences, Ensystex II	100
tebuconazole	Elite, Folicur, Orius, various	F	Bayer, various	4,000
tebufenozide	RH 5992	I	Dow AgroSciences	> 5,000
tebupirionfos[1]	see phostebupirim[1]	—	—	—
tebuthiuron	Spike	H	Dow AgroSciences	579
tefluthrin[1]	Force	I	Syngenta	20-35
tembotrione	Laudis	H	Bayer	> 2,000
temephos	Abate	I	Clarke	8,600-13,000
terbacil	Sinbar	H	DuPont	> 5,000
terbufos[1]	Counter	I	BASF	1.6
terramycin (calcium oxytetracycline)	Terramycin	F	Nufarm	low toxicity
tetrachlorvinphos	Rabon	I	various	4,000-5,000
tetraconazole	Domark	F	Valent	1,248
tetramethrin	various	I	various	4,640
thiabendazole	Arbotect, Mertect	F	Syngenta	3,810
thiamethoxam	Actara, Centric, Cruiser, Platinum	I/Mi	Syngenta	1,563
thidiazuron	Dropp, Ginstar, Leafless	HA	Bayer, Uniroyal	> 5,000
thifensulfuron-methyl	Harmony, Pinnacle	H	DuPont	> 5,000
thiodicarb	Larvin	I/Mi	Bayer	66
thiophanate methyl	3336,Spectro, Topsin	F	Cerexagri, Cleary, various	7,500
thiram	Spotrete	F/Rep	Cleary, various	780
tralkoxydim	Achieve	H	Syngenta	934-1,324
tralomethrin[1]	Saga, Scout X-TRA	I	AgrEvo, Bayer	1,000-1,250
triadimefon	Bayleton	F	Bayer	317-568

Table 1.16 - Chemical Information Chart (cont.)

Common Name or Designation ([1]=restricted use)	Trade Names Other Names	Action	Company	Acute LD_{50} Values for White Rats- Oral (mg/kg) Technical
triadimenol	Baytan	F	Gustafson	700-1,200
tribenuron-methyl	Express	H	DuPont	> 5,000
tribuphos (tribufos)	Def 6, Folex 6	HA	Aventis, Bayer, Micro-Flo	250
tributyltin[1]	various	B, F, M	various	46
trichlorfon	Dylox	I	Bayer	560-630
Trichoderma harzianum	Plantshield, Rootshield, Turfshield	F	Bioworks	low toxicity
triclopyr	Garlon	H	Dow AgroSciences, various	713
trifloxystrobin	Compass, Flint, Gem	F	Bayer	> 4,000
trifloxysulfuron-sodium	Envoke, Monument	H	Syngenta	> 5,000
triflumizole	Procure, Terraguard	F	Crompton	2,230
trifluralin	Preen, Treflan, Tri-4, various	H	BASF, Dow AgroSciences,	> 10,000
triforine	Funginex	F	Scotts	> 16,000
trinexapac-ethyl	Primo	PGR	Syngenta	> 5,000
triphenyltin hydroxide[1]	AgriTin	F	Nufarm	108
uniconazole	Sumagic	PGR	Valent	2,020
vinclozolin	Ronilan	F	BASF	> 10,000
warfarin	Rodex	R	Bell, Haco, various	186
zinc phosphide[1]	Gopha-Rid, various	R	Bell, various	45.7
ziram	Ziram	F	Cerexagri	1,400
zoxamide	Zoxium	F	Dow AgroSciences	> 5,000

Protecting Honey Bees

Richard D. Fell, Entomologist, Virginia Tech

The poisoning of honey bees and other beneficial insects by pesticides can be a serious problem. Honey bees provide a valuable service to agriculture because they are the most important pollinators of cultivated crops. They also produce honey and beeswax. Efforts should be made to protect honey bees whenever pesticides are used. The protection of honeybees has become even more critical in recent years because of increased colony loss due to mite parasites and Colony Collapse Disorder (CCD)

Causes of Bee Poisoning

1. Most bee poisoning occurs when insecticides are applied to crops in bloom. This includes crop plants such as sweet corn, which is routinely sprayed when in tassel. Honey bees collect pollen from corn tassels.
2. The application of insecticides to fields with weeds that are in bloom. The spring application of insecticides to alfalfa fields with flowering weeds is a particular problem in Virginia.
3. Drift of toxic sprays or dusts onto adjoining crops or weeds that are in bloom.
4. The contamination of flowering ground-cover crops in orchards when spray applications are made.
5. The contamination of water. This includes water collected by bees for drinking and cooling the hive as well as contact with contaminated water or dew on foliage or flowers.
6. The use of systemic insecticides and the possible contamination of nectar and pollen. This is a concern with the use of neonicotinoid insecticides, such as clothianidin, imidacloprid, and thiamethoxam, although more research is needed.

The most serious problems occur when bees collect contaminated pollen or nectar and carry these materials back to the hive. Insecticidal dusts (particularly Sevin) and encapsulated insecticides are especially dangerous because they adhere to foraging bees and may be collected and stored in the hive with pollen. Such materials can cause serious bee kills within the hive for many months.

Ways to Reduce Bee Poisoning

1. When using pesticides that are hazardous to bees, notify the beekeeper so that he may move or protect his hives.
2. Do not apply insecticides that are toxic to bees to crops in bloom.
3. Use insecticides that are less toxic to bees when such choices are consistent with pest control recommendations (see the table of relative toxicities).
4. Choose the least hazardous formulations when possible. Dusts and encapsulated insecticides are more toxic than sprays of the same material. Wettable powder sprays tend to have a longer residual effect (and are more toxic) than emulsifiable concentrate sprays. Granular applications are usually the safest method of treatment around bees.
5. Avoid drift of toxic sprays onto ground-cover plants, weeds, and crops in nearby fields.
6. Control weeds in fields and avoid direct insecticide applications to flowering weeds whenever possible.
7. If ground-cover plants in orchards are in bloom, mow before spraying.
8. Apply insecticides when bees are not actively foraging, either in the late evening or early morning. This is particularly important with crops such as corn where evening applications avoid many problems since pollen release occurs in the morning. In general, evening applications are least hazardous.
9. Avoid direct treatment over colonies.

Relative Toxicity of Pesticides to Honey Bees by Laboratory and Field Tests

Group I. Highly Toxic

Severe losses may be expected if these pesticides are used when bees are present at treatment time or within a day ***thereafter***.

Abamectin
Acramite (bifenazate)
Actara, Centric, Platinum, Helix, Cruiser, Adage (thiamethoxam)
Address (acephate)
Admire (imidicloprid)
Advantage
Afugan (pyrazophos)
Ambush (permethrin)
Ammo (Fury) (>.025 lb/acre) (cypermethrin)
Apollo (clofentezine)
Arsenicals
Asana (esfenvalerate)
Avaunt (Advion) (indoxacarb)
Avid (avermectin)
Azodrin (monocrotophos)
Baygon (propoxur)
Baytex (fenthion)
Baythroid (cyfluthrin)
BHC
Bidrin (dicrotophos)
Capture, Annex, Brigade (bifenthrin)
Carzol
Cidial (phenthoate)
Clutch (clothianidin)
Commodore (lambda-cyhalothrin)
Curacron (profenofos)
Cygon (dimethoate)
Cymbush
Cythion (malathion)
Danitol (fenopropathin)
Dasanit (fensulfothion)
DDVP (dichlorvos)
Delegate, Radiant (spinetoram)
Denim (emamectin benzoate)
Dibrom (naled)
De-fend, Dimate (dimethoate)
Diazinon (spectracide)
Dimecron (phosphamidon)
Dursban, Eradex (chlorpyrifos)
Ectrin (fenvalerate)
Endigo
Envidor (spirodiclofen)
EPN
Ethyl guthion (azinphos-ethyl)
Famphos (famphur)
Ficam (bendiocarb)
Folimat
Fipronil
Furadan F (carbofuran)
Fury (zeta-cypermethrin)
Gardona (tetrachlorvinphos)
Guard Star (permethrin)[1]
Guthion (azinphos-methyl)
Imidan (phosmet)
Karate
Lannate D (methomyl)
Lindane
Lorsban (chlorphyrifos)
Malathion (Malathion G)
Matacil (aminocarb)
Mesurol (methiocarb)
Methyl parathion
Monitor (methamidophos)
Nemacur P (phenamiphos)
Nexter (pyridaben)
Nudrin (methomyl)
Orthene (acephate)
Parathion
Pay Off (flucythrinate)
Phosdrin (mevinphos)
Phosphamidon
Poncho, Titan, Clutch (clothianidin)
Pounce (permethrin)
Proaxis (gamma-cyhalothrin)
Proclaim (emamectin)
Provado (imidachloprid)
Pydrin (fenvalerate 0.1 lb/A)[2]
Pyramite
Rebelate (dimethoate)
Resmethrin
Scout (tralomethrin)
Sevin (carbaryl)[3]
Spectracide
Steward (indoxacarb)
Sumithion (fenitrothion)
Supracide (methidathion)
Swat (bonyl)
Synthrin (resmethrin)
Tameron (methamidophos)
Temik (aldicarb)
TEPP
Vapona (dichlorvos)
Venom (dinotefuran)
Warrior (lambda-cyhalothrin)
Zectran (mexacarbate)
Zephyr (Agri-Mek) (abamectin)

[1]Can be applied to ground in front of beehives for the control of small hive beetles.
[2]Can be applied in the late evening at rate of 0.1 lb/A or less.
[3]Some formulations of Sevin XLR are rated as moderately toxic.

Group II. Moderately Toxic

These can be used around bees if dosage, timing, and method of application are correct, but should not be applied directly on bees in the field or at the colonies.

Abate (temophos)
Acramite (bifenazate)
Agritox (trichloronate)
Assail (acetamiprid)
Banol (carbanolate)
Bolstar (sulprofos)
Calypso (thiacloprid)
Carzol (formetanate)
Chlordane
Ciodrin (crotoxyphos)
Coumaphos[1] (Agridip, Asunthol)
Counter (terbufos)
Decis, Battalion (deltamethrin)
Di-Syston (disulfoton)
Dyfonate (fonofos)
endrin
Esteem (pyriproxyfen)
Ethodan (Ethion)
Korlan (ronnel)
Larvin (thiocarb)
Metasystox (demeton-s-methyl)
Metasystox R (oxydemeton-methyl)
Mocap (ethoprop)
Oil sprays (superior type)
Pirimor (pirimicarb)
Pyramat
Rhonthane (RDE)
SpinTor (Conserve SC) (Entrust) (spinosad)
Systox (demeton)
Trigard (cyromazine)
Thimet (phorate)[2]
Thionex (endosulfan)
Trithion (carbophenothion)
Vydate (oxamyl)

[1]Checkmite (coumaphos) strip can be used in beehives to treat for varroa mites and small hive beetles.
[2]Thimet EC should only be applied during late evening.

Group III. Relatively Nontoxic

These can be used around bees with a minimum of injury

Acaraben (chlorobenzilate)
Acarol (bromopropylate)
Agri-Mek (avermectin)
Allethrin
Altosid (methoprene)
Amitraz
Apollo (clofentezine)
Applaud, Centaur (buprofezin)
Aza-direct (azadirachtin)
Bacillus thuringiensis (Accoate, Biotrol, Dipel, Thuricide)
Calypso (thiacloprid)
Chlorantraniliprole
Chloroparacide (chlorbenside)
Confirm (tebufenozide)
Cyd-X (CM granulovirus)
cyrolite
Dessin (dinobuton)
Dimilin (diflubenzuron)
Dinocap (Karathane)
Dylox (trichlorfon)
Ethrel (ethephon)
Esteem (pyriproxyfen)
Fujimite (fenpyroximate)
Fulfill (pymetrozine)
Heliothis polyhedrosis virus
Intrepid (methoxyfenozide)
Isomate
Kanemite (acequinocyl)
Kelthane (dicofol)
Mavrik (fluvalinate)[1]
methoxychlor (Marlate)
Morestan (oxythioquinox)
Murvesco (fenson)
Neemix (Align) (azidirachtin)
Neotran
nicotine
Omite (propargite)
Ovotran (ovex)
Pentac (dienochlor)
Plictran [mitacid] (cyhexatin)
Pynamin
Pyrellin (rotenone/ pyrithrin)
pyrethrum (natural)
rotenone
ryania
Rynaxypyr
(chlorantraniliprole)
sabadilla
Saphos (menazon)
Savey (hexythiazox)
Spur (fluvalinale)
Surround (kaolin)
tetram
Trigard (cyromazine)
Vendex (fenbutatin oxide)
Zeal (etoxazole)

[1]Fluvalinate is used in Apistan strips to treat beehives for varroa mites. It is illegal to use Mavrik in hives.

Fungicides

As a general rule, fungicides are safe to use around honey bees.

Afugan (pyrazophos)
Arasan (thiram)
Benlate (benomyl)
bordeaux mixture
Bravo (chlorothalonil)
Captan
copper oxides
copper oxychloride sulfate
copper sulfate
cupric hydroxide (Kocide)
Cyprix (dodine)
Dithane D-14 (nabam)
Du-Ter (fentin hydroxide)
Dyrene (anilazine)
ferbam
Karathane
Maneb
Mancozeb
Morocide (binapaeryl)
Mylone (dazomet)
Phygon (dichlone)
Plantvax (oxycarboxin)
Polyram (metriam)
Rovral (iprodione)[2]
sulfur
Syllit (dodine)
Terraguard[1],
Procure (triflumizole)
Vitavax (carboxin)
Zerlate (Ziram)
Zineb

[1] May increase the toxicity of neonicatinoid insecticides to honeybees if used together.
[2] May cause loss of honeybee larvae. Use with caution where bees are foraging.

Herbicides, Defoliants and Dessicants

Atrex (atrazine)
Alanap (naptalam)
Amiben (chloramben)
Amitrol
Ammate
Balan (benefin)
Banvel (dicamba)
Betanal AM (bentanex)
Bladex (cyanazine)
cacodylic acid
Caparol (prometryn)
Cotoran (fluometuron)
2,4-D
Daconate (MSMA)
dalapon
2,4-DB
2,4-DP (dichlorprop)
diquat
DSMA
Endothal (endothal)
Eptam
Folex (desmedipham)
Glyphosate
Gramoxone (paraquat)
Herbisan (EXD)
Hyvar (bromacil)
IPC (propham)
Karmex (diuron)
Kerb (proamide)
Lasso (alachlor)
Lorox (linuron)
MCPA
Paarlan (isopropalin)
paraquat
Pendimethalin (Prowl)
Phenmedipham (Betanal)
Pramitol (prometone)
Princep (simazine)
Probe (methazole)
Ramrod (propachlor)
Ronstar (oxadiazon)
Sencor (metribuzin)
Sinbar (terbacil)
Surflan (oryzalin)
Sutan (butylate)
Tordon (picloram)
Treflan (trifluralin)