Cornell Pesticide Guidelines for Managing Pests Around the Home

(see Part I of Pest Management Around the Home for cultural guidelines)





Cornell University Cooperative Extension

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1. Pesticide Management Options

1.1 What are Pesticides?

The Environmental Protection Agency defines a pesticide as "any substance or mixture of substances intended to prevent, destroy, or mitigate any insects, rodents, nematodes, fungi, or weeds, or other forms of life declared to be pests and any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant." This definition includes biorational and chemical pesticides. Biorational pesticides include biochemical products (pheromones, hormones, and enzymes) and microbial products (viruses, bacteria, protozoa, nematodes, and fungi). In turn, the microbials consist of two groups: products whose active ingredients occur in nature and those whose active ingredients are genetically engineered. Chemical pesticides are chemicals, of either natural or synthetic origin, that kill or protect against pests such as insects, weeds, plant pathogens, rodents, and other kinds of animal and plant life.

1.2 Home Remedies

Although gardeners claim that certain herbs, onions, garlic, and other plants will repel insects, evidence for such claims is scarce. Numerous commonly available products such as vegetable cooking oils, soap, and baking soda have pesticidal properties as do concoctions made from plant extracts such as mint, citrus peel, and marigolds. Both state and federal regulatory agencies prohibit their use on a commercial basis (even though they are environmentally safe and inexpensive); to comply with these regulations we are obliged to refrain from recommending them in most cases. We do list a few home remedies in this publication, but these remedies are not endorsements by Cornell University of any product or procedure, nor are they recommendations for use either express or implied. Neither Cornell University nor its employees or agents is responsible for any injury or damage to person or property arising from the use of this information.

1.3 Types of Pesticides

Pesticide groups are based on the organisms they control:

Bactericides – in agriculture, used to protect plants from bacterial diseases.

Biopesticides – also known as biological pesticides) pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.

Defoliant – a pesticide causing a plant to lose its foliage

Desiccant – a pesticide drawing moisture (liquids) from a plant or plant part, causing it to wither and die.

Disinfectant – a pesticide or other chemical that killing or inactivating a disease-producing microorganism such as bacteria.

Fungicide – used in protecting plants, animals, or humans from fungal diseases.

Growth regulator – a pesticide chemical altering the normal growth or reproduction of a plant or insect.

Herbicide – used in killing unwanted vegetation, either selectively or generally.

Insecticide – used in protecting humans, animals, and plants from insect annoyances, injury, and destruction.

Miticide or Acaracide – used in protecting humans, animals, and plants from tiny spiderlike animals called mites.

Molluscicide – used in killing snails and slugs.

Nematicide – used in controlling plant-parasitic nematodes (microscopic worms usually associated with roots).

Repellent – a pesticide keeping or driving insects or other pests away from the plant, animal, or surface treated.

Rodenticide – used in killing rats, mice, and other rodent pests.

See "Pest Management Around the Home: Part 1, Cultural Methods" for cultural pest management guidelines.

1.4 Application Equipment

Good basic tools as well as novelty tools are available for applying pesticides. **Sprayers** are the most versatile and usually the most efficient means of applying pesticides.



Pressurized cans containing pesticides are the most convenient (and most expensive) spray applicators. They are useful for making spot treatments on plants and on walls, cracks, and crevices, both inside and outside the home. Be sure the label lists your selected use.

Pressurized Can

The hose-end sprayer is an

easy means of applying sprays. Their quality varies. A good one can become useless if not cared for properly. A hose-end sprayer is basically a siphon. The pesticide is placed in a bottle attached to a



Hose-end Sprayer

2. Types of Pesticides

2.1 Introduction

Pesticides include insecticidal soaps, horticultural oils, biopesticides, botanicals and minerals, and synthetic chemical pesticides and insect repellents.

2.2 Minimum-risk Pesticides

The EPA identifies some pesticides as minimum-risk pesticides. These products are exempt from the requirements of the Federal Insecticide, Fungicide, and Rodenticide Act or FIFRA.

Several criteria must be met before a product is considered minimum risk. A minimum-risk pesticide must have an active ingredient that's on the list of exempted active ingredients found in the federal regulations (40 CFR 152.25). The following active ingredients were considered exempt from the requirements of FIFRA as of May, 2012:

Castor oil (U.S.P. or equivalent) Cedar oil Cinnamon and cinnamon oil Citric acid Citronella and citronella oil Cloves and clove oil Corn gluten meal Corn oil Cottonseed oil Dried blood Eugenol Garlic and garlic oil Geraniol Geranium oil Lauryl sulfate Lemongrass oil Linseed oil Malic acid Mint and mint oil Peppermint and peppermint oil 2-Phenethyl propionate (2-phenylethyl propionate) Potassium sorbate Putrescent whole egg solids Rosemary and rosemary oil Sesame (includes ground sesame plant) and sesame oil Sodium chloride (common salt) Sodium lauryl sulfate Soybean oil Thyme and thyme oil White pepper Zinc metal strips (consisting solely of zinc metal and impurities)

A minimum-risk pesticide must also contain inert ingredients that are listed on the most current List 4A published in the Federal Register. This list is updated periodically. The most current list can be accessed on the web at: www.epa.gov/opprd001/inerts/section25b_ inerts.pdf.

In addition to meeting the previously mentioned active and inert ingredient requirements, a minimum-risk pesticide must also meet the following requirements:

- Each product must bear a label identifying the name and percentage (by weight) of each active ingredient and the name of each inert ingredient.
- The product must not bear claims either to control or mitigate microorganisms that pose a threat to human health, including but not limited to disease-transmitting bacteria or viruses, or claims to control insects or rodents, carrying specific diseases, including, but not limited to, ticks that carry Lyme disease.
- The product must not include any false or misleading labeling statements.

2.3 Insecticidal Soaps

These specially formulated soaps contain potassium or sodium salts of certain fatty acids. They have become popular because of their low toxicity to humans, pets, and many beneficial insects.

Insecticidal soaps are one of the safest choices available for controlling pests in the garden or on ornamental plants. They control adelgids, aphids, mealybugs, whiteflies, mites, among other pests.

Insecticidal soaps work only on contact. The spray solution must coat the pest. Once the spray has dried, another insect is unharmed by walking over the residue. For example, spraying only the upper leaf surface leaves whiteflies alive and healthy because they usually feed on the undersurfaces of the leaves. Whitefly immature stages move little or not at all and will not be killed by contact with the wet material.

Spray only when and where an infestation appears, not as a preventive measure. Symptoms such as leaf or shoot distortion, sooty mold, and holes in leaves require further investigation to determine the cause and the extent of an infestation. Once you find the pest, treat only affected plants or spots.

Watch for phytotoxicity, an adverse plant reaction, or injury, from the soap treatment. Symptoms on foliage include yellow or brown spotting, "burned" tips, and yellow or brown scorching on leaf edges. Soap spray may also cause marking on certain pome (e.g., apple, pear) and stone fruit varieties. Phytotoxicity is perhaps most people's greatest concern when using insecticidal soap.

2.3.1 Avoidance of Plant Injury

Do not use insecticidal soap on stressed plants. Drought is a major stress factor. Newly planted ornamentals,

3. Pesticide Use

3.1 Introduction

Handle pesticides with care. Most pesticides are toxic, which makes them effective against unwanted pests but also poisonous to humans and animals. Used according to label instructions, however, they present minimal risks to people and the environment.

Pesticide labels are discussed in detail in Chapter 4 of this bulletin.

Store pesticides in clearly labeled, original containers, out of reach of children and animals. Keep pesticides in locked storage facilities. Dispose of empty containers so children cannot play with them and according to label directions.

Directions for use, including application rates and precautionary statements, are given on the product label. Additional information about toxicity and hazards can be obtained from the Material Safety Data Sheet (MSDS) for the pesticide in question. MSDSs are a source of information about emergency and first-aid procedures and handling spills and leaks. You should be able to obtain an MSDS on any pesticide from either the place of purchase or the manufacturer. Manufacturers are required to list their address on the pesticide label.

3.2 Pesticide Control Legislation

All pesticides are regulated by state and federal laws to protect the user and consumer. Pesticides that are highly toxic, persist in the environment, or pose some other significant risk to humans or wildlife are placed on a restricted-use list by EPA. A lead agency in each state, such as the New York State Department of Environmental Conservation (DEC), can add pesticides to the restricteduse list for that state. These restricted-use pesticides (RUPs) must be clearly labeled and may be purchased and used only by certified applicators. If you have questions about the status of a pesticide, consult your Cornell Cooperative Extension educator. No restricted-use materials for consumer use are mentioned in this bulletin. Mention of a restricted-use material is only included when a consumer is likely to encounter the name when working with a certified pesticide applicator.

3.3 Certification

Commercial applicators of pesticides, as well as private applicators who use restricted-use pesticides, must be certified. Certification exams are given throughout the state. Consult your Cornell Cooperative Extension educator or a DEC regional pesticide specialist if you have questions concerning certification.

3.4 Neighbor Notification Law

The Neighbor Notification Law applies to schools and daycare centers throughout New York State. Homeowners, commercial pesticide applicators, and pesticide retailers are also affected in the NY counties that have adopted the law. As of this writing, Albany, Erie, Monroe, Nassau, Rockland, Suffolk, Tompkins, Ulster, Westchester, and the 5 counties of the New York City area (Bronx, Kings, New York, Queens, and Richmond) participate in this law.

The Neighbor Notification Law was signed in to law on August 21, 2000 and amends Title 10 of Article 33 of the Environmental Conservation law regarding commercial and residential lawn application of pesticides. The law requires that before any commercial lawn application, the applicator must enter into a written contract with the owner (or owner's agent) of the property to which the application is to be made. The law also requires the posting of specified visual notification markers. These provisions apply to all commercial lawn applications throughout the state.

The Neighbor Notification Law added to Title 10 a mechanism to allow counties and New York City to pass a local law to "opt into" a set of requirements including posting of visual notification markers by homeowners for a residential lawn application, posting of informational signs at retail establishments selling general-use lawn care pesticides and, for certain commercial lawn applications, procedures for advance notification to occupants of dwellings, multiple dwellings, and other structures on abutting property.

The regulations governing pesticide applications (Part 325 of the New York State Rules and Regulations) include a section that outlines what's required to comply with the Neighbor Notification Law. These regulations pertain to pesticide applicators conducting commercial lawn applications, persons conducting residential lawn applications, and placement of signs at retail sellers of general-use lawn pesticides.

3.5 Active and Inert Ingredients

A packaged pesticide, or end-use product, that is available for purchase consists of an active ingredient and inert ingredients. The active ingredient is the chemical responsible for pesticidal activity. It must be listed on the label along with its percentage by weight in the container. A product with a low concentration of active ingredient is less hazardous to handle than one with a high concentration of the same active ingredient. Inert ingredients are not listed by name on the label but may include materials such as water or flammable and toxic solvents such as xylene. They are added to give bulk to the end-use product and to reduce its overall toxicity by diluting the active ingredient. They also serve as solvents or carriers to spread the pesticide evenly on the surface.

4. The Pesticide Label and Some Pesticides Available for Home Use

4.1 Introduction

The label identifies the chemicals in the container and uses signal words to state the toxicity of the pesticide to humans. The label also lists protective equipment needed for proper handling and use of chemicals. This may include masks, gloves, and respirators. Do not take chances with your health – follow the safety requirements listed on the label.

The label lists the registered uses for the pesticide that are approved by the Environmental Protection Agency (EPA). The pesticide label is the result of years of research and development. The statements on the label must be reviewed and approved by the EPA before the product can be sold. EPA registration does not guarantee or imply the safety of a pesticide, however. If the intended use is not listed on the label, do not use the product. You are legally responsible for any accident or loss resulting from using materials that are not approved. The recommended doses and directions for application also appear on every label. Most labels state which other pesticides can be mixed with the pesticide (i.e., the compatibility with other pesticides). Phytotoxicity information is also included to let you know if a pesticide is likely to injure plants.

The label is the law! Pesticide users are forbidden to use a pesticide in a way contrary to its labeling. Any use not indicated on the label is prohibited.

The instructions on the label are like a prescription: they state how much pesticide to mix; how, when, and where to apply it; and precautions to be observed. The label also lists specific organisms to be protected – bees, fish, and so forth. Be aware of sensitive areas that must be protected from pesticide drift. Reread the label each time you use a pesticide. It is the responsibility of the applicator to comply with all this information. Do not rely on your memory!

4.2 Sample Pesticide Label

A sample label is given on the next page. Items with a superscript number are described in detail below.

4.3 Parts of the Label

1. Product, Brand, or Trade Names

Each manufacturer has a brand name for its product. Different manufacturers may use different names for the same active ingredient. The brand name almost always appears on the label in large print. Such names as Sevin, Bayleton, and Sluggo are trade names that refer to a specific chemical product. Other trade names such as Raid, Ortho, and Agway do not identify a single product, active ingredient, or special use.

2. Type of Pesticide

The type of pesticide is usually listed on the front panel of the pesticide label. This short statement usually indicates the pests that it will control, for example, insecticide for control of certain insects on fruit trees, soil fungicide, herbicide for control of annual broadleaf weeds, or multipurpose fruit-tree spray.

3. Classification

Each use of every pesticide is classified by the EPA as either "general" or "restricted." Every pesticide product that has been restricted by the EPA must carry the following statement "RESTRICTED-USE PESTICIDE. For sale and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification," in a prominent place at the top of the front panel of the pesticide label. Restricteduse pesticides are not included in this bulletin.

4. Ingredient Statement

Each pesticide label must list what is in the product. This list is written so that you can quickly find what the active ingredients are and the percentage of each ingredient. Ingredient statements must list the official chemical names, common names for active ingredients, or both. Inert ingredients need not be named, but the label must show what percentage of the contents they comprise.

Since pesticides may have complex chemical names, many are given a shorter common name. Only EPA-approved common names may appear on the label. Examples are *Bacillus thuringiensis* var. *kurstaki* (Bt), carbaryl, and malathion. When a common name is not available, the chemical or biorational name must be used in the active ingredients section of the label. If it is overly complex or non-informative, a descriptive name is permitted. Read these names with care, particularly in accident cases. The chemical names of entirely different insecticides may differ only slightly. In addition, one chemical may have two or more correct chemical names that are alternative ways of writing the formula.

5. Signal Words and Symbols

Almost every label contains a signal word to give you a clue to how dangerous the product is to humans. The signal word must appear in large letters on the front panel of the pesticide label. It is usually next to the statement, "Keep out of reach of children," which must appear on every pesticide label. (See Table 3.1 in Chapter 3 of this publication.)

6. First Aid or Statement of Practical Treatment

This may be on the side panel or the front. This statement tells you the first aid treatments recommended in case of poisoning. An emergency assistance phone number may be

Table 4.1. Examples of Products for Pests Indoors and Outdoors Around the Home

Refer to chapter 2 of this publication for minimum-risk pesticides, which are exempt from EPA registration and are not listed below. Refer to Part I: Cultural Methods, for management alternatives without pesticides or minimum risk pesticides. This table does not list all brands or multi-ingredient pesticides. Other products are available. Check product labels: some may be used indoors; others are for outdoor use only. Search chemical pesticide hyperlinks for the appropriate situation. Review the pesticide label before purchasing and application. No product endorsement is implied.

Pesticide	Chemical class	Signal word	Examples (with EPA Reg. #)	Manufacturer
Boric acid (continued)		Caution	Hot Shot Maxattrax Roach Killing Powder with Boric Acid 2 (8660- 20203-8845)	United Industries
Boron sodium oxide tetrahydrate	Mineral (boron compound)	Caution	Termite Prufe (9608-3)	Copper Brite
Carbaryl	Carbamate	Caution	Apicide (36272-14)	Mystic Chemical Products
Cyfluthrin	Synthetic pyrethroid	Caution	Do It Best Home Insect Control 2 (192-221-75111)	Value Garden Supply
Cypermethrin	Synthetic pyrethroid	Caution	Raid Ant & Roach Killer 17 (4822- 447)	S. C. Johnson & Son, Inc.
DEET (N-N- diethyl-3- methylbenzamide, formerly N,N- diethyl-meta- toluamide)		Warning	3M Ultrathon Insect Repellent 8 (58007-7)	3M Co.
Deltamethrin	Synthetic pyrethroid	Caution	Bayer Advanced Powerforce Carpenter Ant & Termite Killer Plus Ready-to-Use (73049-185-72155)	Valent Biosciences Corp.
		Caution	Bonide Household Insect Control Ready to Use (4-440)	Bonide Products
		Caution	Bonide Termite and Carpenter Ant Dust (4-441)	Bonide Products
		Caution	Terro Ant Dust (149-12)	Senoret Chemical
		Caution	Terro Carpenter Ant & Termite Killer RTU Spray (149-13)	Senoret Chemical
Diatomaceous earth (silicon dioxide)	Mineral (diatomaceous silica)	Caution	J. T. Eaton Kills Bedbugs and Crawling Insects Powder (56-67)	J.T. Eaton & Co.
,	,	Caution	AnteaterPantry Bug Powder (63191- 13)	St. Gabriel Organics
d-Limonene (mentha-1,8 diene)	Botanical	Caution	Citracide Insecticide (61887-1- 11547)	Orange Guard
		Caution	Orange Guard (61887-1)	Orange Guard
Fipronil	Phenylpyrazole	Caution	Combat Outdoor Ant Stakes (64240- 30)	Combat Insect Control
Hydramethylnon	Aminohydrazone	Caution	Amdro Kills Ants & Roaches Bait (2724-498-73342)	Wellmark International
Hydroprene	Insect growth regulator	Caution	Raid Plus Egg Stoppers (4822-400)	S.C. Johnson & Son
Imidacloprid	Neonicotinoid	Caution	Bayer Advanced Dual Action Roach Killer Powder Pen RTU (72155-70)	Bayer Advanced
Imiprothrin	Synthetic pyrethroid	Caution	Raid Ant & Roach Killer 17 (4822- 447)	S. C. Johnson & Son, Inc.

5. Management Practices for Household Pests

5.1 Introduction

If you need to use an insecticide indoors, explore your options and choose the least toxic material. Apply in limited amounts and provide adequate ventilation during and after application. Boric acid or diatomaceous earth, often considered least toxic choices, may be sufficient to control the pest. Be sure that all the pesticides you use are *household formulations* and that the pest and the site are clearly listed on the label. Uses inconsistent with the label are illegal and could be dangerous.

If you hire a pest management professional (PMP), choose one using least toxic pest management practices. Take all necessary safety precautions: vacate or ventilate premises; prevent children or pets from coming in contact with treated surfaces until completely dry; remove pet food, water, and bedding during application; remove or cover fish tanks and air pumps during applications.

For pests such as fleas, treat pets at the same time the structure is treated, and be prepared to dispose of or wash all pet bedding.

Specific chemicals registered for control of household pests are listed in Table 5.1 (for toxicity information, see Table 3.1 in Chapter 3, and Table 4.1 in Chapter 4). Be sure to see Chapter 4 in "**Part I: Cultural Methods**, of **Pest Management Around the Home**", for nonpesticidal means of managing pests.

5.2 Further Reading

Fact sheets on specific pests may be available. Check with your local Cornell Cooperative Extension office or visit them online at www.cce.cornell.edu.

Common Sense Pest Control Quarterly. Bio-Integral Resource Center newsletter. P.O. Box 7414, Berkeley, CA. 94707.

Common Sense Pest Control; Least Toxic Solutions for Your Home, Garden, Pets, and Community. Olkowski, W., S. Daar, and H. Olkowski. 1991. Taunton Press, Newtown, CT. 715 pp.

IPM Practitioner. Bio-Integral Resource Center newsletter. P.O. Box 7414, Berkeley, Calif. 94707. Handbook of Pest Control. 6th ed. Mallis, A. 1982. Franzak & Foster, Cleveland, OH. 1101 pp.

Managing the Cluster Fly. Insect and Plant Disease Diagnostic Laboratory fact sheet. Insect and Plant Disease Diagnostic Laboratory, Dept. of Entomology, Comstock Hall, Cornell University, Ithaca, NY. 2 pp.

Pest Control for Home and Garden. Hansen, M. 1993. Consumer Reports Books, Yonkers, NY. 372 pp.

Subterranean Termites. USDA Home and Garden Bulletin 64. Washington, DC. 30 pp.

Table 5.1. Annoying pests inside the home

Also see Chapter 4 in Part I: Cultural Methods, of Pest Management Around the Home.

Pests	Some Pest Management Options
Ants	Ant baits are the best management tactic for many ants, as they control entire colony. Baits for home use come prepackaged, contain an insecticide and food attractant, and should be in plastic child-resistant containers. Do not use other insecticides or cleaners with baits. Baits may take a little longer to work, but are a better choice.
3/16 to 5/16 inch	Baits do not work for winged swarmers. Spot treatment with an insecticide where ants enter may be helpful. Registered pesticides include: boric acid, cyfluthrin, deltamethrin, diatomaceous earth, fipronil, d-Limonene, lambda-cyhalothrin, permethrin, and propoxur (Baygon). Sometimes ants nest in wall voids. If the problem persists, you may want to consult a Pest Management Professional. See also Carpenter ants .
Bed bug Jain Stranger	Management should focus on non-pesticide methods first, including vacuuming, sealing cracks and crevices (hiding places), using zippered mattress covers (after thorough clean- up), and keeping beds from touching walls. If the problem persists, you may want to consult a Pest Management Professional. Pesticides should never be used on a mattress unless the product label specifically states that it can. For indoor treatment, cyfluthrin, deltamethrin, diatomaceous earth, or permethrin, are labeled to treat hiding places around baseboards, moldings, and floorboards.

6. Houseplant Pest Management

6.1 Introduction

Various methods are available for managing houseplant pests. The pest, number of plants infested, size of the planting, and inclination of the caretaker determines the best methods. Some insects and spider mites may be able to be washed off plants with a strong stream/spray of water. Predatory or parasitic insects may be effective in some plantings. Removal of individual insects with a cotton swab dipped in rubbing alcohol can also be effective for some scales and mealybugs. Table 6.1 lists some registered pesticides for houseplants (for toxicity information see Table 3.1in Chapter 3, and Tables 4.2 and 4.3 in Chapter 4).

6.2 Pesticides

Many of the pesticides available for use on houseplants are formulated in ready-to-use pressurized cans or as pump sprays. Make sure the selected product is labeled for use *indoors* and on *houseplants*. Other formulations may cause plant injury (phytotoxicity) or plant death. All pesticides labeled for use on houseplants should be applied outdoors.

Plant spikes containing insecticides may also be available. Be sure to follow label directions carefully checking for the amount to use, how to water, storing unused spikes, precautionary statements, and hazards to humans. Wash hands thoroughly with soap and water after handling, or better yet, wear disposable gloves and discard after use.

6.3 IPM Considerations

For a general description of some common insects and diseases on houseplants and for information management of houseplant pests and diseases without pesticides, see Chapter 5 in **Part I: Cultural Methods**, of **Pest Management Around the Home.**

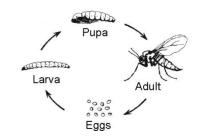
Consider removing infected leaves or discarding infested plants rather than treating with a toxic substance. Most chemical pesticides are effective at protecting plants against disease but cannot "cure" existing infections. If **houseplants need to be sprayed, remove them from the living space for treatment.** If weather allows, take the plants out of doors or into a garage to make the application. Bring plants back indoors when dry.

6.4 Fungus Gnats

Fungus gnats are small flies that can sometimes be a problem indoors, especially if houseplants are kept constantly moist. Adult fungus gnats are attracted to damp locations where fungi are likely to flourish, such as houseplant potting mix. Larvae feed primarily on fungi, but occasionally attack roots of growing plants. Adult gnats may become nuisance pests. Avoid keeping potting mixes too wet and prevent accumulations of stagnant water in pot saucers or other containers. To check for the presence of fungus gnat larvae in potting mix, cut a small potato in half, place cut side down, and lightly press into mix. Leave for 3 to 4 days, then lift up and look for shiny white larvae with black heads. For adult monitoring and capture, yellow sticky cards can be used: place on rim of pot. Larvae may be controlled using B.t.i. (*Bacillus thuringiensis* var. *israelensis*), or beneficial nematodes (*Steinernema feltiae*).

Life cycle of a typical fungus gnat species, *Bradysia* corophila:

- Adult gnats live approximately 7 days.
- The female lays up to 150 eggs, which hatch in approximately 5 days.
- Larvae grow for 10 to 14 days, and then pupate.
- The pupal stage lasts approximately 3 to 4 days, before developing into an adult fungus gnat.



Fungus gnat life cycle

6.5 Further Reading

Common Sense Pest Control Quarterly. Bio-Integral Resource Center newsletter. P.O. Box 7414, Berkeley, CA. 94707.

Compendium of Flowering Potted Plant Diseases.

Daughtrey, M. L., R. L. Wick, and J. L. Peterson. 1995. American Phytopathological Society, St. Paul, MN. 90 pp.

Compendium of Ornamental Foliage Plant Diseases.

Chase, A. R. 1987. American Phytopathological Society, St. Paul, MN. 114 pp.

Diseases of Geraniums. Horst, R. K., and P. E. Nelson. 1985. Cornell Cooperative Extension Information Bulletin 201. Ithaca, NY. 33 pp.

The Healthy Indoor Plant. Powell, C. C., and R. Rossetti. 1992. Rosewell Publishing, Box 2920, Columbus, OH 43216. 297 pp.

IPM Practitioner. Bio-Integral Resource Center newsletter. P.O. Box 7414, Berkeley, CA. 94707.





Powdery mildew on rose. The white or pale gray coating on leaf surfaces, dusty or fuzzy in appearance, is typical of powdery mildew on many kinds of plants.

Table 6.1 Notes:

- Consider removing infected leaves or discarding infested plants rather than treating with a toxic substance. Most chemical pesticides are effective at protecting plants against disease but cannot "cure" existing infections.
- Check all pesticide labels carefully. Products may not be registered on all varieties or may not be tested on all rare or unusual varieties. If the host and pest are not listed on the label, do not use the pesticide.
- If houseplants need to be sprayed, remove them from the living space for treatment. If weather allows, take the plants out of doors or into a garage to make the application. Bring plants back indoors when dry.

Table 6.1. Houseplant pesticide guidelines

Also see Chapter 5 in Part I: Cultural Methods, of Pest Management Around the Home.

Plant	Pest	Some Pest Management Options
African violet	Botrytis blight (gray mold)	Apply hydrophobic neem oil or copper soap (copper octanoate), one time, following cultural plant sanitation practices.
	Powdery mildew	Apply hydrophobic neem oil or copper soap (copper octanoate), per label directions.
	Cyclamen mites	No pesticides available. Discard infested plant. Isolate new plants for three to four months before placing in your collection.
	Mealybug	Use insecticidal soap (potassium salts of fatty acids) or hydrophobic neem oil. Systemic imidacloprid for use in potted houseplants is available, but is not registered for home use in the New York counties of Kings, Queens, Nassau, or Suffolk.
	Root mealybug	Apply insecticidal soap, using drench treatment as specified on label.
Asparagus fern	Aphids	Spray with insecticidal soap (potassium salts of fatty acids), hydrophobic neem oil, or horticultural oil. Some products should not be used on delicate ferns; test a small leaf first. Systemic imidacloprid for use in potted houseplants is available, but is not registered for home use in the New York counties of Kings, Queens, Nassau, or Suffolk.
Begonia	Bacterial leaf spot (Xanthomonas sp.)	Apply Bacillus subtilis per label directions.
	Botrytis blight (gray mold)	Apply <i>Bacillus subtilis</i> , hydrophobic neem oil, or potassium bicarbonate.
	Powdery mildew	Apply <i>Bacillus subtilis</i> , hydrophobic neem oil, or potassium bicarbonate.

Begonia continued on next page.

7. Management of Annoying Pests Outside the Home

7.1 Determining Pest Control Needs

Before deciding that control is needed, answer the following questions:

- 1. Have you correctly identified your pest problem? If in doubt, your local Cornell Cooperative Extension office or garden center may be able to help.
- 2. Is the "pest" really a problem? Many insects are occasional invaders of homes and buildings and may only enter under adverse weather conditions or at one time of year. Many of the 'pests' listed may not be problematic. Insects resting on sunny surfaces may not enter a dwelling or cause harm.
- 3. If you believe a pesticide is needed, have you chosen the proper pesticide for your situation and are you applying it in the correct way at the right time? Applying a pesticide for cluster flies, for instance, in June would be totally ineffective. If flies are a problem in June, they are not cluster flies, which only begin to enter buildings in mid- to late August.
- 4. Have you planned to prevent future outbreaks? Eliminate harborage outdoors near the house foundation. Regular maintenance can help keep numbers of insects and arthropods low outside the home and may prevent them from getting indoors. Do not allow birds to nest on or adjacent to the building. Mites that feed on birds often get into homes from these nests once the young have fledged. Tighten and repair screening. Clean up brush, accumulated dead leaves, and other debris; trim trees and shrubbery so that they do not touch the building; and select plants and mulching materials carefully to avoid future pest problems.

Table 7.1 lists some pesticides and other management options for annoying pests outside the home (for toxicity information, see Table 3.1 in Chapter 3, and Table 4.1 in Chapter 4). Remember that pesticides are only one choice for managing pests and that they are temporary measures. Consider developing an integrated pest management plan optimizing cultural techniques for the future.

7.2 Further Reading

Common Sense Pest Control Quarterly. Bio-Integral Resource Center newsletter. P.O. Box 7414, Berkeley, CA. 94707.

Common Sense Pest Control; Least Toxic Solutions for Your Home, Garden, Pets, and Community. Olkowski, W., S. Daar, and H. Olkowski. 1991. Taunton Press, Newtown, CT. 715 pp.

Complete Guide to Pest Control: With and Without Chemicals, 3rd ed. 1996. Ware, G. W. Thomson Publications, Fresno, CA. 388 pp.

IPM Practitioner. Bio-Integral Resource Center newsletter. P.O. Box 7414, Berkeley, CA. 94707.

Pest Control for Home and Garden. Hansen, M. 1993. Consumer Reports Books, Yonkers, NY. 372 pp.

Tick Biology for the Homeowner: entomology.cornell.edu/ extension/medent/tickbiofs.cfm

Mosquito Biology for the Homeowner: entomology. cornell.edu/extension/medent/mosquitofs.cfm

West Nile Virus information: entomology.cornell.edu/ extension/medent/westnilefs.cfm

Cornell Insect Diagnostic Lab factsheets: entomology. cornell.edu/cals/entomology/extension/idl/idlfactsheetlist. cfm

U.S. EPA – How to Use Insect Repellents Safely: www.epa.gov/pesticides/insect/safe.htm

Table 7.1. Management of annoying pests outside the home.

Search pesticide hyperlinks for the appropriate situation. Review the pesticide label before purchasing and application. Also see Chapter 6 in **Part I: Cultural Methods, of Pest Management Around the Home**.

Pest	Some Pest Management Options		
Ants	Ants are beneficial, helping to clean up the environment. They feed on a variety of things including dead insects, other animal matter, sweets, starches, and fats. Ants will enter houses in search of food. Exclusion by caulking and other home repair helps keep them out. Locate and eliminate nesting sites.		
3/16 to 5/16 inch See also Carpenter Ants	Ant baits are the best management tactic for many ants – they control the entire colony. Baits that offer both a sweet and protein matrix work well for many species. Ingredients in baits may include Boric acid, hydramethylnon (an insect growth regulator), abamectin, or fipronil.		

Ants continued on next page.

9. Annual and Perennial Plant Pest Management

9.1 Introduction

Common diseases of annual and perennial plants include damping-off, root and stem rots, leaf spots and blights, rusts, powdery mildew, downy mildew, vascular wilts, and virus and nematode diseases. Insect pests include aphids, plant bugs, leafhoppers, spittlebugs, mealybugs, scales, thrips, whiteflies, mites, caterpillars, beetles, wasps, leafminers, and borers. For additional information on nonpesticidal alternatives to managing pests in annual and perennial flowers in the home garden, see Chapters 2 and 8 in **Part I: Cultural Methods, of Pest Management Around the Home**.

To keep the plants healthy and attractive, you should be able to diagnose common insect and disease problems and formulate an appropriate treatment plan. This plan should include cultural control measures such as proper site preparation, diversified plantings, sanitation during and after the growing season, disease-free transplants and seed, crop rotation, and scouting (checking for pests and disease symptoms). Remember to use the least toxic measures to manage pest problems. In some cases, pests such as aphids and spider mites can be washed off with a strong stream of water.

For all plant diseases, practice plant sanitation. When plants are not wet, carefully remove and destroy or discard affected plant parts or portions thereof. In autumn, rake and remove all garden debris. Avoid wetting foliage if possible. Water early in the day so aboveground plant parts will dry as quickly as possible. Avoid crowding plants; space plants apart to allow air circulation; prune or thin plants or plantings. Table 9.1 covers many of the common insect pests and diseases of annual and perennial plants found in the home garden. Roses and vines (such as clematis) are discussed with other woody ornamental plants in Chapter 10 - Tree and Shrub Pest Management. It is a good idea to test a product first on a small portion of the plant or planting to see if it causes any adverse effects on the plant(s). Varieties or cultivars may differ in their reaction to pesticide products. For toxicity information, see Table 3.1 in Chapter 3 and Tables 4.2 and 4.3 in Chapter 4.

9.2 Further Reading

Compendium of Chrysanthemum Diseases. Horst, R. K. and P. E. Nelson. 1997. American Phytopathological Society, St. Paul, MN. 88 pp.

Compendium of Flowering Potted Plant Diseases.

Daughtrey, M. L., R. L. Wick, and J. L. Peterson. 1995. American Phytopathological Society, St. Paul, MN. 90 pp.

Diseases of Annuals and Perennials. Chase, A. R., M. L. Daughtrey, and G. W. Simone. 1995. Batavia, IL. Ball Publishing. 202 pp.

Diseases of Geraniums. Horst, R. K., and P. E. Nelson. 1982. Cornell Cooperative Extension Information Bulletin 201. Ithaca, NY. 30 pp.

Westcott's Plant Disease Handbook. 7th Ed. Horst, R. K. 2008. Van Nostrand Reinhold, New York. 1008 pp.

Table 9.1 Notes:

* **Plant Sanitation**: Carefully remove and destroy or discard affected plant parts, at a time when plant parts are not wet. In autumn, rake and remove all garden debris. Avoid wetting foliage. Water early in the day so aboveground plant parts will dry quickly. Avoid crowding plants; space plants apart to allow air circulation; prune or thin plants or plantings.

** **Imidacloprid**: Products containing imidacloprid are not registered for use in certain New York City and Long Island counties (Kings, Queens, Nassau, and Suffolk). Most formulations of imidacloprid once available to homeowners are now classified as restricted-use (for professional application only) in New York State. Check product status and label prior to purchase.

Table 9.1. Annual and perennial pest management

Also see Chapter 8 in Part I: Cultural Methods, of Pest Management Around the Home.

Plant	Pest	Some Pest Management Options
Ageratum	Spider mites	Wash off with a strong stream of water. If necessary, apply: acephate, insecticidal soap (potassium salts of fatty acids), lambda-cyhalothrin, Mite-X (plant extracts), or neem oil.

Plant	Pest	Some Pest Management Options
Ageratum (continued)	Whitefly	Apply as necessary: acephate, cyfluthrin, insecticidal soap (potassium salts of fatty acids), lambda-cyhalothrin, malathion, neem oil, or permethrin.
		Spray two or more times at five-day intervals. Good coverage of leaf undersides is important for control. Repeat spraying only if necessary.
Chrysanthemum	Fungal leaf spot	Practice plant sanitation.* (see note). Apply if needed: <i>Bacillus subtilis</i> , chlorothalonil, copper ammonium carbonate, neem oil, potassium bicarbonate, or sulfur.
	Powdery mildew	Practice plant sanitation* (see note). Apply if needed: <i>Bacillus subtilis</i> , copper ammonium carbonate, neem oil, potassium bicarbonate, or sulfur.
	Rust	Practice plant sanitation* (see note). Apply if needed: <i>Bacillus subtilis</i> , myclobutanil, neem oil, potassium bicarbonate, or sulfur.
	Viral diseases	Remove affected plants and destroy. Management of insect vectors (such as aphids or thrips) may not be completely effective, especially if weeds or other nearby plants harbor the virus.
Powdery mildew	Aphids	Wash off with a strong stream of water. If necessary apply: acephate, cyfluthrin, insecticidal soap (potassium salts of fatty acids), lambda- cyhalothrin, malathion, Mite-X (plant extracts), neem oil, permethrin, or pyrethrins plus PBO.
	Beetles	Handpick and discard beetles. If necessary, apply carbaryl or cyfluthrin
	Borers	Cut and bury large-stemmed weeds nearby that may serve as alternate host and sources of infestation. No pesticides are available for borers.
	Caterpillars	Handpick and remove caterpillars. If necessary, use Bt (<i>Bacillus thuringiensis</i> ssp. <i>kurstaki</i>), carbaryl, cyfluthrin, lambda-cyhalothrin, neem oil, permethrin, pyrethrins plus PBO, or spinosad.
	Plant bugs (including four-lined plant bug)	Apply as necessary: carbaryl, insecticidal soap (potassium salts of fatty acids), or lambda-cyhalothrin.
	Spittlebugs	Apply as necessary: carbaryl, cyfluthrin, lambda-cyhalothrin, neem oil, or pyrethrins plus PBO.
Cockscomb (Celosia)	Fungal leaf spot	Practice plant sanitation* (see note). If needed, apply neem oil or sulfur.
	Spider mites	Wash off with a strong stream of water. If necessary apply: insecticidal soap (potassium salts of fatty acids), or Mite-X (plant extracts).
Columbine (Aquilegia)	Fungal leaf spot	Practice plant sanitation* (see note). Apply if needed: <i>Bacillus subtilis</i> , neem oil, or sulfur.
	Aphids	Wash off with a strong stream of water. If necessary, apply: cyfluthrin, insecticidal soap (potassium salts of fatty acids), Mite-X (plant extracts), or neem oil.
	Leafminer	Handpick and destroy mined leaves. If necessary, use lambda-cyhalothrin or spinosad. Spray three times at weekly intervals, beginning when leaves are about half-grown.
	Sawfly (larvae)	Remove by hand. If needed, use carbaryl, insecticidal soap (potassium salts of fatty acids), or spinosad.

Table 9.1. Annual and perennial pest management

Also see Chapter 8 in Part I: Cultural Methods	of Pest Management Around the Home .
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