



Personal Safety in the Commercial Greenhouse

Safety in the workplace is a team responsibility involving the owner, manager, cashier, seasonal, and part-time employee. A positive attitude toward creating a safe environment and being aware of potential problems extends to all who are involved in greenhouse operations.

Create a pesticide-free zone for your customer

It is important to maintain a pesticide-free zone for customers and visitors of the greenhouse business. This area should include merchandise that is on display, such as flower containers, pots or baskets, books, packaged seeds, and checkout computers, as well as service areas (i.e., restrooms or reading rooms). Plants should not be treated with pesticides in any indoor area that is intended for public display or customer service. If plants need to be treated with pesticides, they should be moved to an area that is off limits to the public.

Pesticide applications

When a pesticide is applied to plants in a greenhouse, pesticide residues in the form of droplets, dust, or vapors generally fall on every exposed surface. Residues will settle not only on the plants but also on the physical surroundings and the applicator's clothing. Research has shown that an amount of active ingredient applied to plants also appears on the protective equipment worn by the applicator. All spray equipment – hoses, sprayers, carts, benches, shelves, pots, wagons, and any items in the areas sprayed or in the preparation areas – should be considered contaminated.

The pesticide residues remaining on surfaces in a greenhouse after spraying continue to be an exposure risk that may extend beyond the restricted-entry interval (REI), the time that must pass before it is considered safe to re-enter a treated area. Because more than one chemical is often required, multiple types of residues occur and can remain active for an unknown time. Therefore, it is best to wear chemical resistant gloves in areas of a greenhouse where pesticides have been applied.

Pesticide labels

The most important printed communication tool are pesticide labels and Safety Data Sheets (SDS). The SDS are technical descriptions of the chemical material, its effects on crops, and hazards to humans and the environment. It is a good idea to file the pesticide labels and the SDS in a notebook in a central area so greenhouse personnel can reference this information. Valuable information on the pesticide label and in the SDS should be readily accessible for medical personnel in case of an accidental pesticide exposure.

The pesticide label contains required information to read prior to application. Labels must include signal words that refer to the relative toxicity of a pesticide, how much pesticide to apply for the pest problem being treated, and emergency medical information for treatment of injuries. The label also includes information about personal protective equipment (PPE) that needs to be worn during contact with the pesticide. In general, the more toxic the pesticide, the more PPE is required. The signal words, toxicity class, and descriptions are listed in Table 1.

Table 1. Pesticide label signal words and toxicity categories

Signal Word	Toxicity Class	Description	Oral Toxicity Statements
Caution (Optional)	IV	Very low toxicity	No statement required
Caution	III	Low toxicity (eye, skin irritant)	Harmful if swallowed
Warning	II	Moderate toxicity (eye, skin irritant)	May be fatal if swallowed
Danger/Danger-Poison	I	Highly toxic by any route of entry into the body (eye, skin corrosive)	Fatal if swallowed

What personal protective equipment should be worn?

Regular, basic work clothing is the first line of defense against pesticide exposure. Socks, shoes, a long-sleeve shirt, and long pants should be worn even if a pesticide has no specific PPE requirements listed on the label. It would be unwise for workers with less clothing to work in areas regularly treated with pesticides.

Additional PPE may be required including eye protection, respiratory protection, and chemical resistant gloves, apron, or footwear. Applicators, however, may decide to wear extra PPE than is specified by the product label.

For example, chemical-resistant gloves may be worn, although only waterproof gloves are required by the pesticide label. If using two products for an application, make sure the label requiring the most PPE is followed.

When a chemical-resistant item is listed on the label, it is referring to PPE that is made of a material that doesn't allow a measurable amount of chemical to pass through. Chemical-resistant may be used to describe certain PPE, such as gloves, footwear, suits, or aprons. Some examples of chemical-resistant materials include nitrile, natural, neoprene, and barrier laminate rubber, and polyvinyl chloride.



Similarly, some labels require PPE to be made of waterproof material, which does not allow a measurable amount of water or pesticides dissolved in water to pass through the item during use.

Types of PPE

The type of PPE that is required is based on several factors, such as the product's toxicity, concentration, and formulation. The Environmental Protection Agency has determined through risk assessment that the specific work clothing or personal protective equipment that is listed on the label must be worn by the applicator to protect themselves from exposure.

Coveralls. Coveralls may be worn over regular work clothing and should fit closely to the neck or have attached hoods to prevent pesticide exposure to the chest or back. Coveralls should not be substituted for work clothing – the extra protection of coveralls over clothing is important.

When a label specifies coveralls, the applicator is required to wear cloth coveralls. If full body chemical-resistance is required (very rarely), the label will specify a chemical-resistant suit.

Reusable (cloth) coveralls are durable and should be washed daily to prevent pesticide buildup in the fabric.

Disposable coveralls may be required on a pesticide label for greenhouse spraying, but they cannot be washed and used repeatedly as can cotton coveralls. A familiar trade name is Tyvek®. Disposable coveralls must be thrown out after the workday or if soiled by pesticides.

Eye protection. Whether specified by the pesticide label or not, using PPE to protect eyes is a good idea. Protective eyewear options include safety glasses with front, brow, and temple protection; chemical splash goggles; face shields; and full-face respirators. If the label calls for protective eyewear, any of the protective eyewear listed above can be worn. If the label specifies a type of protective eyewear (e.g., face shield), then that specific eyewear must be used. These devices should have impact-resistant lenses and provide good peripheral vision.



Chemical resistant gloves (Photo by University of Nebraska PSEP)

Gloves. Hand protection is essential for greenhouse workers who apply pesticides or work with plants, pots, or growing media that have been treated with pesticides. Gloves may be waterproof or chemical resistant, depending on pesticide label directions, and their costs are similar.

Glove liners. Separable glove liners made of a thin lightweight fabric may be worn beneath chemical-resistant gloves as long as they are not exposed to the chemical by extending outside of the chemical-resistant gloves. Separable glove liners are not to be confused with cotton- or fleece-lined gloves, which are not allowed because they could absorb pesticides and contaminate the applicator.

Respirators. Some pesticide labels require the use of a respirator to protect the lungs because pesticides can be inhaled as dusts, mists, or vapors. Respirators help remove harmful contaminants from the air breathed during pesticide work.

Greenhouse employers must supply each pesticide applicator with a label-specified respirator. Before an applicator can use a respirator, they must receive:

- A medical evaluation by a physician or other licensed healthcare professional,
- Fit-testing with a taste/smell/irritating indicator, and
- Training about the use, care, and maintenance of the respirator.

The National Institute of Occupational Safety and Health (NIOSH) approves respirators for various types of hazardous activity. A respirator may be marketed as “NIOSH approved” or with a TC number, meaning it has been tested and certified. The two general types of air-purifying respirators are:

1. Particulate filter-mask respirators offer protection from short exposures to dusts and particulates that may be encountered in repotting or cultivation activities, but they do not protect against harmful vapors. These filters physically trap solid or liquid particles like dust or mist from air drawn through the filter. Most filter masks are not suitable for pesticide work and cannot be used in highly toxic atmospheres. Contaminants eventually plug up the respirator, so breathing gradually becomes more difficult. These masks must be discarded at the first sign of an odor or taste coming through them.



Particulate filter-mask (Photo by 3M Corporation)

2. Cartridge respirators (full- or half-face) are designed as organic vapor cartridges containing activated charcoal – a chemical that adheres to carbon-containing gases (organic vapors). Air is drawn through the cartridge and helps to prevent these types of contaminants from entering the lungs. Cartridge filters are marketed with color codes to signal different hazards. For example, black is the color code for cartridges to be used with organic



Half-face cartridge respirator (Photo by University of Nebraska PSEP)

vapors associated with pesticides. The protective life of a cartridge varies with the contaminant, the capacity of the absorbent material in the cartridge, the concentration of air contaminants, a person's breathing rate, and the ambient temperature and humidity.

Several precautions must be followed in the use of chemical-cartridge respirators.

- Filtering face piece (disposable) respirators are intended to be used by a single person.
- The cartridge must suit the contaminant hazard. Refer to the pesticide label or SDS to learn if respirators are required and the type needed.
- Cartridges lose their absorptive capacity rapidly after the original packaging is removed.
- The facemask and the cartridges must be designed for each other; that is, a cartridge for “Respirator ABC” will not fit “Respirator XYZ” properly.
- Chewing gum, chewing tobacco, etc. cannot be used with respirators.
- Facial hair is not an option when using tight-fitting respirators unless it does not protrude through the respirator seal or extend enough to interfere with the device's valve function.

- The filters or filtering face piece must be replaced before further respirator use when one of the following conditions is met:
 - If a pesticide odor is smelled or nose or throat irritation is felt, leave the work area and change the respirator cartridge
 - When breathing resistance becomes excessive
 - If the filter element has physical damage or tears
 - According to the manufacturer's recommendations or pesticide product labeling, whichever is more frequent
 - In the absence of any other instructions or indications of service life, at the end of eight hours of cumulated use
- Follow the manufacturer instructions for care of the respirator.

More information can be found at:

<http://pesticideresources.org/wps/respirators.html>.

Aprons. When spraying plants on benches or working with plants that have been sprayed, an apron made from chemical resistant materials is suggested, if not specified on the pesticide label. It should cover the front of the body from mid-chest to the knees.



Chemical resistant apron (Photo by Kevin Arrowsmith)

Footwear. Pesticide labels may require footwear made from chemical resistant material. Chemical resistant footwear may consist of: 1) chemical resistant shoes; 2) chemical resistant boots; or 3) chemical resistant coverings worn over street shoes or boots. It is suggested that this type of footwear be worn for any pesticide application and that street shoes or boots be kept in a locker for use outside of the workplace.

Supply sources for PPE

Most types of PPE can be found at safety supply stores. Also check farm supply stores, agricultural chemical suppliers, online, or mail-order safety supply companies. Examples include, but are not limited to: B&T Grower Supply, Inc.; Gempler's; SHOWA; or Superior Glove Works, Ltd.

How to clean reusable PPE

Clean PPE immediately after wearing according to the manufacturer's instructions or pesticide product labeling instructions. In the absence of any such instructions, wash PPE thoroughly in detergent and hot water. Do not wash chemical resistant PPE in a washing machine.

Glove liners should be **discarded after ten hours of use or within 24 hours of initially putting on the gloves, whichever comes first**, since laundering will not sufficiently remove pesticides from the fabric. Glove liners must be removed and discarded immediately if they contact pesticides directly. Disposable PPE must be discarded after the work day or if soiled by pesticides.



Washing cartridge respirator base (Photo by Kevin Arrowsmith)

All other clothing worn during pesticide application should be considered contaminated. Comply with any applicable federal, state, tribal, and local regulations when disposing of PPE that cannot be cleaned.

Coveralls and work clothing worn for pesticide application should be kept separate from family clothing both before and during washing to prevent pesticide transfer to clothing of other family members. Laundering will not remove all traces of pesticide residue from clothes, but it will reduce contamination levels to very small or trace amounts.

For more information about laundering pesticide contaminated work clothes, see

<https://www.ag.ndsu.edu/publications/crops/laundry-pesticide-contaminated-work-clothes>.

PPE storage, changing, and cleanup room

Greenhouse workers should have a changing and cleanup room that is separate from pesticide storage and mixing or preparation areas. A restroom shared by the greenhouse staff and customers is not appropriate. The changing room should be free of clutter and equipment storage. It should be dedicated to providing privacy for workers to change from their personal street clothing into their greenhouse work clothing. This room should include private lockers for each worker with hangers to keep personal clothing from being contaminated by their own or co-handlers' protective work clothing and PPE or that of others that is worn for work in the greenhouse. The changing room should include a shower, soap, and clean towels to clean up after pesticide application.

It is a good idea to have a washing machine and dryer installed near the changing room to maintain greenhouse work clothes so that they do not have to be taken home or to a public laundry where they might contaminate other people's clothing. This room also should have a container in which to dispose of contaminated disposable pesticide work clothing, such as coveralls, gloves, and dust masks. PPE should be worn when emptying this container or preparing it for disposal. If a greenhouse operation does not currently supply uniforms, consider obtaining them and make the laundering of these uniforms part of one employee's work assignment.



Pesticide storage

Pesticides should be secured when not in immediate use. A separate room or commercially available storage building is best for this purpose. Metal lockers, cabinets, or shelves can also be used to store pesticides if they are in an area that can be locked. The storage area should have direct access to the pesticide transportation and delivery area so that chemicals do not have to be taken through customer sales areas.

Whatever type of storage or lockup area is used, those areas should be off-limits to everyone except the employer and applicators. If the storage area is a walk-in type, it is important to consider how to prevent a person from being locked inside.

No endorsement of products or firms is intended, nor is criticism implied of those not mentioned. Suggestions in this publication are intended to alert pesticide users to safety concerns; however, following these procedures cannot guarantee total protection from pesticides.

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Except as noted, all photos courtesy of Mark H. Shour.

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