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Addressing the Science Surrounding Glyphosate

UC ANR's charge is research and extension and we provide guidance about how to manage weeds using registered pesticides and by non-chemical methods. UC ANR includes information in its publications on how to effectively and safely use glyphosate where it is legal to do so as well as provide options for alternative chemical and non-chemical approaches for managing weeds.

UC ANR recognizes that the use of any pesticide carries risks, including in some cases the possibility of acute (immediate), chronic (long term) or carcinogenic effects, to those who may be exposed to them. This is true of any pesticide, which includes herbicides such as glyphosate.

UC ANR has not specifically addressed carcinogenicity or other health issues related to glyphosate; these are areas of active research, data interpretation, and debate over inferences, conclusions, and courses of action in the scientific community and regulatory bodies as well as in the public discourse. However, to date, regulatory agencies in the United

States have not significantly changed the legal uses of glyphosate herbicides.

What is risk?

The specific risks of a pesticide are a function of both hazard (toxicity) and exposure; the risks from more hazardous materials can often be reduced by minimizing exposure (e.g. strictly following the directions on the label, using proper personal protective equipment, and using appropriate application methods). Conversely, high exposure levels (e.g. large concentrations, frequent exposure, long-term exposure) to a relatively lower hazard material has the potential to increase health risks.

What is glyphosate?

Glyphosate is the active ingredient in herbicides such as the Roundup branded products as well as many other herbicides marketed under a variety of trade names. Glyphosate has been available since 1974 and is widely used by farmers, ranchers, landscapers, wildland managers, and home gardeners in California and around the world. This herbicide is used in a variety of systems because it is effective at controlling a wide range of annual and perennial grassy and broadleaf plants. Glyphosate herbicides typically are applied to the foliage of emerged plants as a diluted spray but there are other application techniques and formulations for



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Application of an herbicide.

specific uses (e.g. cut stump treatments, no-surfactant formulations for some aquatic uses). Most glyphosate herbicides used in agriculture and commercial applications are sold as concentrated products that are then diluted in water before use; homeowner products may be either concentrates or sold in pre-diluted "ready to spray" packages.

How toxic is glyphosate?

Glyphosate has been placed in Toxicity Category III by the US EPA. Toxicity Category I indicates the highest degree of acute toxicity, and Category IV, the lowest. People may become exposed to glyphosate and other pesticides directly by getting it on their skin or in their eyes or indirectly through environmental

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contamination such as food and water contamination. Applicators must follow label instructions with regard to personal protective equipment (PPE). Whether or not specifically required by the product label, wearing long pants, closed toed shoes, chemical resistant gloves, and protective eye-wear will reduce the risk of glyphosate exposure. Even if chemical-resistant gloves are worn, people should always wash their hands after applying pesticides, and before activities such as eating, smoking, or using the restroom. Most glyphosate products available for the homeowner indicate on the label that people and pets may enter the treated area after the spray has dried.

What about cancer?

In 2015, the International Agency for Research on Cancer (IARC), a non-regulatory organization, reviewed the published scientific literature on the carcinogenicity of glyphosate alone and in formulations. Based on their review, the IARC classified glyphosate as “probably carcinogenic to humans” and put it in group 2A. This category is used when there is limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals.

Other groups such as the World Health Organization (WHO) and United Nations Food and Agriculture Organization (FAO) also examined the scientific literature on glyphosate. The joint FAO/WHO report concluded that glyphosate alone or in a formulation is unlikely to cause a carcinogenic risk to humans from exposure in the diet. The U.S. Environmental Protection Agency (US EPA), the regulatory agency that determines how pesticides may be used legally in the U.S. also concluded that it is not likely a cancer risk.

Glyphosate was added to California’s Proposition 65 list (chemicals known to the state to cause cancer or reproductive toxicity) in 2017 because California regulations require chemicals listed in IARC hazard group 2A to be put on the Prop 65 list unless their report was deemed to have “less than sufficient evidence of carcinogenicity in humans and animals.”

Weeds can have negative impacts on agriculture, public health, natural resources, and our economy. Likewise, pest control practices also have a range of potential impacts and outcomes. UC ANR promotes the use of Integrated Pest Management (IPM)

strategies, including cultural and mechanical practices, and herbicides when needed. If glyphosate or any other herbicide is used to manage weeds, the pesticide label must be followed to ensure these products are used safely and legally for minimal exposure to applicators, non-target organisms, and our environment.

For more information about weed management practices and the safe and effective use of pesticides, visit the UC IPM website at ipm.ucanr.edu.

For detailed information about glyphosate or any other pesticide, visit the National Pesticide Information Center website at npic.orst.edu or call 1-800-858-7378 Monday–Friday, between 8:00 a.m.–12:00 p.m. Pacific Time. The National Pesticide Information Center provides objective, science-based answers to questions about pesticides.

Developed by a team of UC ANR Advisors and Specialists with expertise in weed science.

For more information: Please contact UC ANR Strategic Communications:

anrcs.ucanr.edu/Strategic_Communications/



Pests in the Urban Landscape

ucanr.edu/blogs/ucipmurbanpests

Subscribe to the UC IPM urban pest management blog!

UC IPM's blog provides readers with timely information about pests in and around homes, gardens, landscapes, and structures in California. We post articles about common seasonal pests, invasive pests, beneficials, and new UC IPM resources, including new and revised Pest Notes, training events, and other educational materials for residential audiences and pest management professionals.

View or subscribe to the blog at ucanr.edu/blogs/ucipmurbanpests/

Applying Glyphosate? Know How to Choose the Right PPE

Public concern about the potential risk of illness from long-term exposure to glyphosate is on the rise. In order to reduce exposure to this common herbicide, or any other pesticide, it's important that applicators wear the right personal protective equipment (PPE), not only for personal safety, but also to comply with California regulations.

Signal words and glyphosate

Pesticide labels contain a signal word, which describes the effects of acute or immediate toxicity from unprotected exposure to the chemical. Signal words are CAUTION, WARNING, DANGER, and DANGER-POISON (see the Spring 2019 issue of the retail newsletter ipm.ucanr.edu/PDF/PUBS/Spring_2019_Retail_Newsletter.pdf).

Most commercial glyphosate products have the signal word “CAUTION,” which indicates the chemical can cause moderate eye irritation, is harmful if inhaled, and to avoid contact with eyes and clothing and breathing in the vapor from spray mist.

Some glyphosate products may have the signal word “WARNING” on the label and advise against contact with eyes or clothing because the product can cause substantial but temporary eye injury including other adverse reactions.

While pesticide labels do not warn against specific chronic health issues associated with their use, PPE, safe handling procedures, and pesticide label instructions reduce long-term or chronic pesticide handler health risks. According to the Agricultural Health Study, chemical-resistant gloves can reduce pesticide exposure between 50 to 80 percent. For more information specific to glyphosate, see the article on page 1.

What are the California regulations?

Most labels for glyphosate-based products have the signal word “CAUTION” and require closed-toed shoes, long sleeves, and pants while making an application. A few glyphosate products do require the applicator to wear chemical-resistant gloves, but this is limited to when the product is mixed and applied at a concentration that is greater than 30 percent.

California pesticide safety regulation for PPE is often stricter than the requirements of the federal pesticide label, mandating at a minimum that protective eyewear and chemical-resistant gloves are worn by licensed applicators, even if they are not mentioned on the federal pesticide label and regardless of the product signal word.

These state requirements for protective eyewear and chemical-resistant gloves for handlers are detailed in the California Code of Regulation Section [6738.1](#) and were adopted by the state more than three decades ago.

In the most recent pesticide injury illness report from 2015, there are 8 cases of handler pesticide illness due to glyphosate. Two of these cases were eye injuries from failure to wear the appropriate PPE in applying glyphosate by itself or in combination with other products, according to a California Pesticide Illness Surveillance Program review.

According to a 2013 review of the previous decade from the California Department of Pesticide Regulation (CDPR), on average, 1 in 3 reports of all pesticide illnesses involving poisoning or skin injury were due to handler failure to wear the appropriate PPE.

Label Code	Materials Required by Law	Material Code
A	1,2,3,4,5,6,7,8	1: Laminate
B	1,2	2: Butyl
C	1,2,3,4,7,8	3: Nitrile
D	1,2	4: Neoprene
E	1,3,4,8	5: Natural
F	1,2,3,8	6: Polyethylene
G	1,8	7: PVC
H	1,8	8: Viton

All but Laminate and Polyethylene must be 14 mils or thicker

Figure 1. Glyphosate product labels may require chemical resistant gloves in the Category A. While the labels provide example glove materials, note that Category A includes all 8 chemical resistant materials.

It is clear that selecting the appropriate PPE and wearing it correctly, reduces the risk of pesticide-related illness. If you do not have access to the right PPE, notify your employer of any equipment issue that interferes with following the requirements on the label and the minimum state requirements for PPE.

PPE for glyphosate handlers

There have been no changes to PPE requirements for any glyphosate herbicide product label since the active ingredient was added to the [Proposition 65 list](#) in July 2017. The Prop 65 list contains chemicals known by the State of California to cause cancer and is maintained by the Office of Environmental Health Hazard Assessment (OEHHA).

For any glyphosate products that have a “WARNING” label, coveralls are required in California, even if it is not required by the label. This rule applies to all products labeled as “WARNING” or “DANGER” in California, not just those containing glyphosate.

When using backpack sprayers that are known to leak during an application, reduce your potential exposure by wearing coveralls even when applying glyphosate products rated “CAUTION.”

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Gloves: If the label does not specify that gloves are required, or if it only states that chemical-resistant or water-proof gloves are required, handlers can choose to wear gloves of any chemical-resistant material, provided they are the appropriate thickness of 14 mils or greater. The California Department of Pesticide Regulation developed a wallet-sized *Glove Category Selection Key* (Figure 1) to help label readers identify the correct glove material for their situation.

Eyewear: Handlers must wear the type of eyewear that is specified by the pesticide product labeling. If the label does not specify that eyewear is required, handlers can choose to wear either a face shield, goggles, or safety glasses that provide front, side, and brow protection.

All types of protective eyewear must be labeled “Z87.1” or “Z87+” to indicate that it meets the 2010 American National Standards Institute standard for impact resistance. This is done using permanent, raised lettering (Figure 2)



Figure 2. Few glyphosate product labels require that applicators wear “protective eyewear.” In California, protective eyewear is mandatory when applying any product, even if the label doesn’t require their use. Eyewear must meet impact resistance requirements with a rating of Z87+ identifiable on the eyewear.

and indicates that the manufacturer certifies that its eyewear meets the defined baseline of protection.

The PPE listed under the precautionary statements of the pesticide label provide a barrier between your body and the pesticide. Remember to read and follow equipment requirements on all labels including complying with the minimum PPE requirements in California to protect yourself from the unwanted effects of acute and chronic exposure.

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- DPR. 2013. Pesticide Illness Surveillance Program. California Department of Pesticide Regulation. cdpr.ca.gov/docs/whs/pisp.htm (accessed Nov. 29, 2018).
- EPA. 2016. Table 3. EPA Chemical Resistance Category Selection Chart for Gloves found in Label Review Manual, Chapter 10: Worker Protection Label. United States Environmental Protection Agency. epa.gov/sites/production/files/2016-02/documents/chap-10-feb-2016.pdf (accessed Dec. 15, 2017).

Upcoming Meetings and Workshops

PestWorld 2019

October 15-18, 2019, San Diego, CA
pestworld2019.org/



UC Riverside Fumigation School

November 5-6, 2019, Riverside, CA
ucanr.edu/sites/ucurbanpest/UCR_Fumigation_School/UCR_Fume_School_2019/

West Coast Rodent Academy

November 6-8, 2019, Irvine, CA
ucanr.edu/sites/WCRA/



Ask the Expert!

Q: My customers don't want me to use glyphosate to control weeds. What can I do instead?

A: There are many options for managing weeds in a landscape using an integrated approach that combines nonchemical and chemical methods.

- Start by identifying the weeds you want to manage. UC IPM has a weed photo gallery that includes most weeds found in California landscapes. Knowing how a weed grows and spreads is an important step in successful control. ipm.ucanr.edu/PMG/weeds_intro.html
- Once you know what weed or weeds you're dealing with, consult the *Pest Notes* series on weeds to find specific management options. ipm.ucanr.edu/PMG/menu.weeds.html
- Management options depend on whether the site is already planted or if you're installing a new landscape. Develop a weed management plan before planting.
- When you're installing new lawns or plantings, you can use soil solarization to control weeds prior to planting. Instructions on how to solarize soil can be found in the *Soil Solarization* Pest Notes at ipm.ucanr.edu/PMG/PESTNOTES/pn74145.html
- Selecting the right plants for your site and planting them at the right time will enable the plants to establish quickly, eliminating the need for additional herbicides.
- Use mulch and geotextiles (landscape fabrics) in landscape plantings to reduce the growth of weeds.
- Choosing drip or subsurface irrigation or micro-sprinklers over rotor and turf-type sprinkler heads will also help in reducing weeds, since the water is placed at or near desirable plants.
- Mow and trim as needed to prevent weeds from forming flowers or seeds.
- Cultivation, such as hand-weeding, can be useful to remove small weeds before they set seed.
- Young weeds in open areas can be controlled with small flaming or infrared units.
- Steam weeder machines are available that use superheated hot water or steam to kill weeds.
- A variety of other herbicides, both preemergence and postemergence, are registered for use in residential and urban landscapes. No single herbicide will control all weeds. Always read the label before use. Be sure to use the correct personal protective equipment to reduce your exposure to the pesticide.



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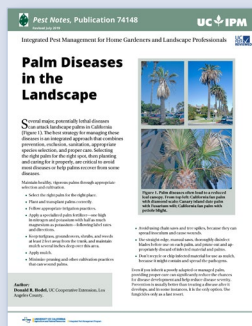


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For more general information, see the Pest Notes on *Weed Management in the Landscape* ipm.ucanr.edu/PMG/PESTNOTES/pn7441.html or *Weed Management in Lawns* ipm.ucanr.edu/PMG/PESTNOTES/pn74113.html.

WHAT IS IPM? Integrated Pest Management (IPM) programs focus on long-term prevention of pests or their damage through a combination of techniques including resistant plant varieties, biological control, physical or mechanical control, and modification of gardening and home maintenance practices to reduce conditions favorable for pests. Pesticides are part of IPM programs but are used only when needed. Products are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

Revised Pest Notes



Palm Diseases in the Landscape

This recently updated *Pest Notes*, authored by UC Cooperative Extension advisor Donald Hodel, features a new section with information on petiole and rachis blights as well as tips to maintain healthy, vigorous palms, disease identification, selecting the right palms, and palm management.

Online at ipm.ucanr.edu/PMG/PESTNOTES/pn74148.html



Pocket Gophers

Learn about updated restrictions on fumigant and rodenticide use, optimal trapping techniques, and new carbon monoxide exhaust machines for use against gophers in gardens and landscapes.

Revised by Roger Baldwin a UC Cooperative Extension Specialist and an expert in Human-Wildlife Conflict Resolution.

Online at ipm.ucanr.edu/PMG/PESTNOTES/pn7433.html



Roses: Cultural Practices and Weed Control

Find information on growing healthy roses in this publication authored by UC Cooperative Extension Advisor John Karlik. It includes examples of new cultivars with color photographs, additional information

on establishing bare-root stock, and updated information about appropriate herbicides for use in controlling weeds in a rose garden.

Online at ipm.ucanr.edu/PMG/PESTNOTES/pn7465.html



Wood Decay Fungi in the Landscape

Trees and other woody plants in the landscape can be decayed by a variety of fungi. Learn how to identify and manage these fungal diseases in this publication revised by UC Cooperative Extension Advisor Jim Downer. This version

includes color photographs, instructions on correct pruning to prevent decay, and details about three new diseases.

Online at ipm.ucanr.edu/PMG/PESTNOTES/pn74109.html

Visit UC IPM's *Pest Notes* web page for these and many more titles ipm.ucanr.edu/PMG/PESTNOTES.

Always read and carefully follow all precautions and safety instructions provided on the pesticide container label, as well as any other regulations regarding the use of pesticides. Not following label directions, even if they conflict with information provided herein, is a violation of state and federal law. No endorsements of named products are intended, nor is criticism implied of products not mentioned.

University of California Statewide Integrated Pest Management Program



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