The Pesticide Label

Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Key to Pesticide Safety and Education

October–December 2014

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REGULATORY UPDATES

Special Local Need Registration

NEW since the last issue of this newsletter:

- For packers of **pineapple** fruit—use of the pesticide **Lime-Sulfur Solution** (Tessenderlo Kerley; **EPA Reg. No. 61842–30**)—requires having a copy of **HI–140001,** valid 2/18/2014 to 2/17/2019.

- For managers of **residential, recreational, natural and commercial landscapes, golf courses, and other non-crop areas**—use of the pesticide **Provaunt®** (Syngenta; EPA Reg. No. 100-1487)—to control *little fire ant*—requires having a copy of **HI–140002**, valid until 12/4/2019—Some notes: • Do not apply to any plants that are grown as harvestable food. • Do not use household utensils for measuring, mixing, or application. • Instructions explain how to mix the product with water, a vegetable oil, xanthan gum, and a protein-based product; types of application equipment allowed; the maximum dosage per acre; maximum number of applications per year; and the minimum number of weeks between treatments.

RENEWED

- For growers of **nonbearing pineapple plants**—use of the pesticide **Lorsban® Advanced** (Dow AgroSciences; **EPA Reg. No. 62719–591**)—requires having a copy of **HI–090001**, valid 10/1/2014 to 9/30/2019.

RECERTIFICATION CREDITS may be earned by certified applicators who score at least 70% on the set of comprehension evaluation questions about the "re certification" articles in this newsletter. These article s have a title followed b y "(recertification)". However, credits may not necessarily be applicable for the following categories: Private 2, Private 3, Commercial 7f, and Commercial 11. The question sets (quizzes) are written and administered by the Hawaii Department of Agriculture staff. To ask about earning recertification credits on Oahu, Kauai, Maui, Lanai, and Molokai, call the Department's Honolulu office at (808) 973-9409 or 973-9424. On Hawaii, call the Hilo office at (808) 974-4143 or 333-2844.

PREPARING AN EFFECTIVE PESTICIDE SPRAY MIXTURE: PART ONE

(recertification)

These short articles about spraying crops and weeds are based on the booklet, Adjuvants and the Power of the Spray Droplet: Improving the Performance of Pesticide Applications*. This booklet (PPP-107) is one of many fine publications by the Purdue Extension Service, Purdue University. It is available for purchase or free download at https://edustore.purdue.edu*

In this article, we present some of the properties of water molecules and pesticide molecules that are important to an effective spray mixture.

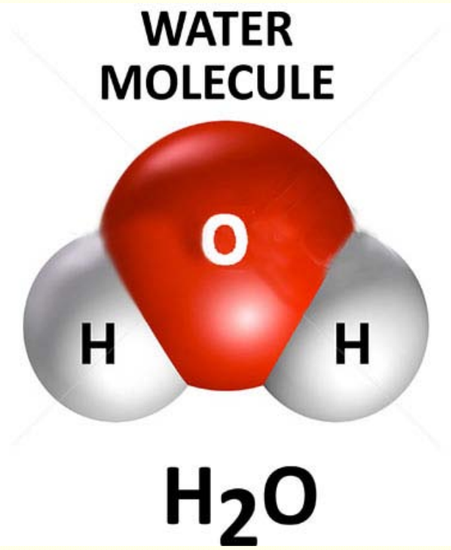
For a pesticide application to be effective, the right product needs to be applied in the appropriate amount. It should be applied evenly using properly calibrated equipment. Other factors can affect the success of the application, but one of the most important and most often overlooked is water quality.

Most pesticide products are formulated to be mixed with water. It is water that carries the pesticide spray to the target site. If a water supply is not appropriate for use with a particular pesticide product, the following problems can occur.

- The pesticide can be deactivated if its molecules bind with minerals in the water.
- The pH of the water can be too acidic or basic and either degrade the pesticide or make it less soluble in the spray mix.
- Smaller droplets can evaporate when they leave the nozzle or be blown off target (spray drift).

- Droplets can bounce, shatter, or roll off of the plant surface (lack of retention).
- Spray droplets may not spread across the plant surface, thus lessening the effect of the pesticide treatment.
- The residue left when the water evaporates may not have uniform amounts of the active ingredient.
- The active ingredient may not be able to enter the plant, thus lessening the effect of the pesticide treatment.

One thing all of these problems have in common is the water in the spray mixture. In a future article we will talk about adjuvants, products that can address some of these problems and make the spray mixture more effective. This article, however, discusses the properties of water and how to mix and apply pesticides so spray applications are more effective.



A water molecule is composed of two atoms of hydrogen and one atom of oxygen. The oxygen atom has a negative charge, the two hydrogen atoms have a weak positive charge. This is called polarity. Water is attracted to other polar compounds, including itself.
Image by ScienceFairWater.com

Properties of Water Molecules

Water is a chemical compound composed of two atoms of hydrogen and one of oxygen, abbreviated H_2O. This simple molecular formula, however, masks a complex molecule. Here are some of the things about water that can improve pesticide spray applications.

- **Water is not pure**. Water contains dissolved minerals like calcium, magnesium, and iron. These and other elements help determine whether the water is acidic or basic, hard or soft. These factors in turn affect pesticide performance.
- **Water is more than a carrier**. Water itself is an active molecule. It does more than just carry the pesticide to the target to be treated. It plays a role in the success of any pesticide application.
- **Water quality varies even over short distances**. Water can vary based on the predominant minerals in an area, whether it is well or surface water, the depth of the well, and the amount of annual rainfall. Water that is clear and tastes good is not necessarily the best choice for a pesticide carrier.
- **Water has polarity**. The oxygen end of the water molecule has a negative charge and the hydrogen end has a positive

Water tends to form droplets due to surface tension. The higher the contact angle between the droplet and a surface, the higher the surface tension and the rounder the droplet. The lower the contact angle, the lower the surface tension and the flatter the droplet. Image from Brocken Inaglory, commons.wikimedia..org

charge. This makes it a polar compound, like the two sides of a magnet. Polarity gives water a very strong attraction to other polar compounds, including itself. For this reason, water is said to be *cohesive* rather than adhesive. For example, it is more likely to be attracted to itself and form droplets than spread across and adhere to plant leaves. Because of this property water can move in all directions, even against gravity. For example, as water at the soil surface begins evaporating, water from below is "wicked" upwards (against the downward pull of gravity) between soil particles to take its place in a process called *capillary action*. Other attached water molecules are also drawn upwards through the soil due to their cohesiveness.

- **Water is a good solvent**. Like water, some pesticide molecules are polar and are attracted to water, just as water molecules are attracted to themselves. When polar organic molecules are attracted to water, they form a solution. It is like adding sugar to water; it dissolves to form a solution. This is a solution because the dissolved sugar (the solute) will not settle out of the water (the solvent).

  Some pesticide products are petroleum-based and are not soluble in water. They disperse and never form a stable mixture because they are much less polar than water. These molecules have little or no charge and are considered neutral, neither positively nor negatively charged. Nonpolar pesticide products must be agitated or the pesticide will separate from the water (the diluent) and form a layer at the top or bottom of the mixture. Some pesticide manufactures add emulsifiers to prevent this separation.
- **Water has a high surface tension**. The high surface tension of water causes it to form droplets on the surface of leaves. This tension creates a high contact angle between the water droplet and the leaf. A low contact angle indicates the droplet has flattened and more of it has come

into contact with the leaf. A high contact angle usually indicates a poor pesticide application. If the contact angle is too low, however, it may create other problems. The goal is to find the right balance.

- **Water is a volatile molecule**. Water can be a solid at low temperatures, a vapor at moderate to high temperatures, and a liquid in between. When a substance evaporates (volatilizes) even at normal temperatures it is said to be volatile. The volatility of water, especially at a low humidity, can lessen the effectiveness of the application. Either the spray droplets evaporate before they contact the target plant or they evaporate from the plant's surface before the pesticide can the absorbed.
- **Water is not a good buffer**. A *buffer* is a solution that resists changes to its pH when an acidic or alkaline substance is added to it. For example, a solution is a buffer if has a pH of 8.5, and after an acid of pH 4.0 is added, the the pH remains at or near 8.5. Water is not a buffer. It takes on the pH of products added to it. Two things determine the level of change in pH of a tank mix with a water as a solvent: the amount of material you add, and the material's actual pH and solubility.

Properties of Pesticide Molecules

Most pesticides are chemically and physically different. These differences affect how they interact with the water itself and with the leaf surface. Pesticides may respond differently to the temperature of water, its pH, or the minerals dissolved in it. As with water, understanding the pesticide in the mixture is important. Here are some important things to know about pesticides in general.

- **Pesticide solubility and degradation rates vary**. The pH of a solution determines how much of the pesticide will dissolve in it and how fast it will degrade or break down after it is dissolved. For each pesticide, there is an ideal pH range. In that range, it is most soluble and most resistant to breaking down. How quickly a pesticide breaks down is known as its *half-life*. This is the time it takes for 50 percent of the pesticide to be destroyed and can be minutes or months.

- **Opposites attract**. If a pesticide with a negative charge is added to water containing dissolved minerals with a positive charge they will bind together. The molecule formed may be too large to enter the plant and so reduce the effectiveness of the spray application. This larger molecule may also be less soluble and precipitate out of the spray mix. It would still be present, but in a form that cannot be used by the plant.
- **How pesticides enter plants**. *Contact* insecticides and fungicides act to prevent damage from insects and fungi at the leaf surface. *Systemic* pesticides must move into and within the plant to be effective, which means it must first penetrate the plant surface. To do this successfully, spray droplets must be: (1) the right size, (2) applied evenly to the leaves, and (3) able to stay on the leaves long enough to be absorbed.

  Pesticides move from the spray droplets into the plant through a process called *passive diffusion*. In this process, pesticide molecules move from an area of greater concentration of pesticide (inside the spray droplet) to an area of lesser concentration of pesticide (inside the plant). Under good conditions passive diffusion will continue until the amount of pesticide inside the leaf equals the amount outside of the leaf. How long this process takes depends on: (1) the properties of the pesticide, (2) the plant species, (3) the characteristics of the leaf, and (4) the thickness of the waxy cuticle.
- **Role of the environment**. Weather conditions at the time of a spray application are important. Strong winds can deflect spray droplets from their target and rain can dilute or wash pesticide from the plant surface. Another important factor is relative humidity. The amount of water

vapor in the air determines how quickly the pesticide spray evaporates from the treated leaf. If the humidity is too low, the spray will evaporate before enough pesticide enters the plant. If the pesticide residue left on the leaf surface is polar, as in most water-based sprays, the dry pesticide will enter the leaf either slowly or not at all. Nonpolar pesticides can still enter the leaf when dry, but usually do so at a much slower rate than when wet.

PREPARING AN EFFECTIVE PESTICIDE SPRAY MIXTURE: PART TWO

(recertification)

In this second of two articles, we discuss the role leaf surfaces and spray droplet size play in the effective preparation and application of a spray mixture.

In the previous article we discussed some basic properties of water. These included its impurities and variability, and the effects its polarity has on water as a carrier. We said pesticides had their own properties and varied their ability or inability to dissolve in water, the rate of decomposition, and how they enter the plant. These properties and how they interact with each other strongly influence the effectiveness of the spray application. This brief article looks at some functions of the leaf surface and how they can affect pesticide performance.

The surface characteristics of this kava (*Piper methysticum*) leaf will partly determine the success of a pesticide application to control this leaf spot fungus. Photo by S. Nelson.

Properties of Leaf Surfaces

The surface of leaves differ among plant species. They can be smooth or hairy, flat or curled, rough and pebbly or fine, deeply veined or flat, and covered with a thin or thick waxy *cuticle*, which is the outer layer of the leaf. These characteristics can determine: (1) how well the spray droplets cover the leaf, (2) whether they remain on the leaf surface, (3) the behavior of the droplets, and (4) the ability of the pesticide to move from the droplets into the leaf.

- **Hitting the target**. The pesticide spray droplets must first hit the leaves. Many factors can prevent this, including: small droplets that miss the leaf or evaporate before reaching it, too many large spray droplets, small or narrow leaves, windy conditions, and poor application technique. More droplets on the leaves mean better potential results.
- **Surface structures**. *Trichomes* or leaf hairs can keep spray droplets from contacting the leaf surface. Droplets must contact the leaf surface to be absorbed.
- **Retention**. After contact with the leaf, the droplets must remain there until absorbed. The force of the application can cause spray droplets to bounce off, shatter, or roll off the leaf. Whether the droplet remains on the leaf also depends on the properties of the droplet itself.
- **Wax repels water**. The nonpolar, waxy plant cuticle is a natural barrier to water. It repels the polar water like wax on a car repels rain. Here is a trade-off: a less polar active ingredient is less soluble in water and may separate out in the spray tank, but it may be more soluble in and able to pass through the waxy cuticle. Pesticides that are more easily dissolved in the wax also move into the plant more easily than those that are solid or crystallized.
- **All waxes are not created equal**. *Hardening off* is a process where plants under high temperatures, low humidity, and lack of water form a thicker waxy cuticle to retain water. The composition of the wax may also vary with plant age, position of the leaf on the plant, and the environment. These conditions can even reduce the effectiveness of herbicides applied to the weed's leaves.

Importance of Droplet Size

The characteristics of a carrier like water, active ingredient, leaf surface, and other factors are important to the success of a pesticide application. Often forgotten, however, are the number and size of droplets produced by the sprayer. A nozzle creating droplets less than 150 microns in size will produce eight times more droplets than a nozzle creating 300-micron droplets. (A human hair is 50–100 microns thick.)

Effect of the spray mix and its application on droplet size

Droplets produced by spray nozzles are not uniform in size. Factors that affect droplet size include nozzle type, size of the hole in the nozzle (orifice), spray pressure, the pesticide itself, and whether adjuvants have been added.

Color Codes for Droplet Size

Category	Symbol	Color Code	Approximate VMD Range
Very Fine	VF	Red	< 150
Fine	F	Orange	150 – 250
Medium	M	Yellow	250 – 350
Coarse	C	Blue	350 – 450
Very Coarse	VC	Green	450 – 550
Extremely Coarse	XC	White	> 550

VMD: Median diameter of droplets. Table courtesy of South Dakota Cooperative Extension Service

- **Nozzle type**. Generally speaking, standard flat fan, even flat fan, twin-orifice flat fan, and hollow cone nozzles produce more small droplets at a given pressure. By contrast, flood and full cone nozzles produce more large droplets. Newer *turbulence-chamber* nozzles and air induction nozzles create even larger droplets.

- **Nozzle output.** Nozzles are rated by the average size of droplets they produce: very fine, fine, medium, coarse, very coarse, and extra coarse (see Table).
- **Orifice size**. Generally, the larger the orifice, the larger the spray droplets.
- **Spray pressure.** Higher spray pressures produce smaller droplets; lower spray pressures produce larger droplets.
- **Adjuvants**. Certain adjuvants—additives that make spray mixes more effective—can affect droplet size. They usually make the spray mix thicker, thus creating larger droplets.

Factors that can affect droplet contact with the target

- **Distance to target**. If distance to the target is too great, smaller droplets may evaporate or drift away from the target. Larger droplets have a greater chance of reaching the target.
- **Environmental conditions**. Low relative humidity will cause droplets to evaporate more quickly. Wind is more apt to blow smaller, lighter droplets off-target than the larger droplets.
- **Canopy density**. Larger droplets are more apt to penetrate a dense canopy of leaves than smaller droplets.
- **Droplet retention by the target**. For the spray application to be efficient, a minimum number of droplets of an adequate pesticide concentration need to be retained by the target. This is generally achieved when most of the droplets are between 150 and 300 microns in diameter.
  - **Smaller droplets (100 microns)**. Coverage of the target is good and droplets do not tend to bounce off. Penetration of the leaf canopy tends to be poor.
  - **Small to medium droplets (200 microns)**. Good coverage, low droplet bounce, good results with contact pesticides. Canopy penetration is moderate.
  - **Medium to large droplets (350 microns)**. Good coverage, good canopy penetration, good results for systemic

pesticides. However, there can be some droplet bounce or spatter.

- **Large droplets (600 microns)**. Good canopy penetration, but low coverage, high droplet bounce and spatter, and reduced effectiveness for many pesticides.

In our next series of articles, we will discuss ways pesticide efficiency can be improved by adding adjuvants. Some adjuvants can also change the consistency of the spray mixture and make it safer to spray by reducing drift.

References

Purdue Extension. 2014. Adjuvants and the power of the spray droplet. Publication PPP-107. www.extension.purdue.edu

Information on nozzles, including Table, from Virginia Extension http://pubs.ext.vt.edu/442/442-032/442-032_pdf.pdf

Cancellation of Selected d-Con® Rodenticide Products

In a 2008 review of rodenticides, EPA determined that bait stations are required for products sold to general consumers for household rodent control. These bait stations must contain a block or paste formulation of the bait and must not contain loose bait. Consumer products are considered by EPA to be those sold in typical retail outlets and containing one pound or less of rodenticide.

As a result of these restrictions, 12 d-Con® brand products are being canceled and phased out of production. Reckitt-Benckiser, the product manufacturer, reached an agreement with EPA to stop production by December 31, 2014 and end distribution to retailers by March 31, 2015. Consumers will still be able to use products already purchased, if used according to label directions. A list of the d-Con products is available at: http://www2.epa.gov/rodenticides/canceling-some-d-con-mouse-and-rat-control-products

In addition to the bait station requirements, four active ingredients used in rodenticide products are no longer available to general consumers: brodifacoum, bromadiolone, difenacoum, and difethialone. These products are second-generation anticoagulants that pose greater risk to non-target wildlife. Because of the delayed action of anti-coagulants, rodents can consume much more than is needed to kill them. This excessive amount of anticoagulant is a danger to wildlife that consumes the dead rodents. Another way to discourage their use by general consumers is to restrict sales to one pound or less of the rodenticide. These second-generation baits will still be available in farm supply outlets or through direct sale to farmers, livestock producers, and professional pest control operators, but they will only be sold in much larger quantities. In California, some of the d-Con products can only be purchased by certified pesticide applicators. More information about the rodenticide mitigation decision is available at:

http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPP-2006-0955-0764

More information on restrictions on rodenticide products are available at http://www2.epa.gov/rodenticides/restrictions-rodenticide-products

This article is based on a report by The Ohio Pesticide Safety Education Program staff, The Ohio State University and an EPA announcement, Updated 20 August 2014 at http://www2.epa.gov/rodenticides/canceling-some-d-con-mouse-and-rat-control-products

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Coffee Berry Borer Found on Oahu

Dorsal view of the coffee berry borer. This small beetle is about 1-2 mm long. Photo by University of Hawaii CTAHR

The coffee berry borer (*Hypothenemus hampei*) was recently found on coffee farms belonging to Dole Foods in Waialua, Oahu. Specimens were submitted to Hawaii Department of Agriculture on 4 December 2014 and confirmed the same day.

On 5 December, 155 acres of coffee plants were surveyed at the site by personnel from the US Department of Agriculture's Pacific Basin Agricultural Research Center, Hawaii Department of Agriculture, and University of Hawaii's College of Tropical Agriculture and Human Resources. They determined the insect was well established, so no attempt will be made to eradicate the infestation, only contain it.

The coffee berry borer (CBB) was first reported in September 2010 in Kona and found in Ka'u in May of the following year. It is unknown how CBB arrived on the Big Island or how it reached Oahu.

Hawaii HDOA requires that all imported green coffee beans be fumigated to kill any pests. Further, under Hawaii Plant Quarantine rules coffee plants and plant parts are not allowed to enter the state.

To protect coffee throughout the state, quarantine rules have been in place since discovery of CBB on the Big Island. A permit is required by HDOA to transport unroasted coffee beans, plants, or plant parts, used coffee bags, and coffee harvesting equipment from Hawaii Island to other uninfested islands. These same rules require treatment and inspection by HDOA before shipping. Only material tagged, labeled, or stamped as having passed inspection can be shipped.

The female coffee berry borer usually enters the cherry through the blossom-end scar, then lays eggs in her tunnels. Larvae feed on the inside of the cherry, then emerge. Photo from hawaii.gov

To read the complete article, visit the Hawaii Department of Agriculture website at http://hdoa.hawaii.gov/blog/main/nrcbboahu/

For more information on the coffee berry borer, see http://hdoa.hawaii.gov/pi/ppc/cbbinfo/

Coconut Rhinoceros Beetle Update

After years of close calls, the coconut rhinoceros beetle (*Oryctes rhinoceros*) finally invaded Hawaii. Nine adult beetles were trapped at Joint Base Pearl Harbor–Hickam on 23 December 2013. (Coincidentally, it was the same day the little fire ant (*Wasmannia auropunctata*) was confirmed on Oahu.) It is thought that the beetle may have arrived in or on an airplane or its cargo.

Adult coconut rhinoceros beetle. Courtesy Hawaii Department of Agriculture

In spite of quick action to contain the beetle by Hawaii Department of Agriculture and others, a male was trapped at Barbers Point on 21 May 2014. On 9 July another beetle was reported at the Campbell Industrial Park, and on 17 October 2014 a beetle was found in a trap near the Diamond Head Lookout. The authorities initially established three buffer zones: a six-mile zone at Joint Base Pearl Harbor–Hickam, a two-mile zone at Campbell Industrial Park, and another two-mile buffer zone around the Diamond Head Lookout. A fourth buffer zone was established around the Leilehua Golf Course, near Mililani, on 21 October with detection of another beetle. The rhinoceros beetle has not been reported on any of the other Hawaiian Islands.

Current numbers show about 1,500 adult beetles captured on Oahu since 23 December: 1,400 at the Pearl Harbor–Hickam base and 60 in the other areas. From August to November of this year, however, the number of adults found in the 2,700 lantern traps around Oahu has decreased by about fifty percent (Star–Advertiser, 20 December 2014). There are still hopes of containing and eradicating this pest.

The adult beetle bores into the crown of coconut trees, damaging new leaves as it feeds on the liquid from the crushed tissue. The feeding creates wedge- or V-shaped cuts in the leaves and makes holes in the midrib. The damaged leaves tend to break under windy conditions. If feeding injures the growing point in the crown of the palm the tree may die. Young trees are easily killed by the beetle. The coconut rhinoceros beetle originated in the Asian tropics. It has spread among the Pacific Islands and is now established in Niue, Palau, Toga, Papua New Guinea, Samoa, American Samoa, and Fiji. The beetle invaded Guam and the Northern Mariana Islands in 2007. Fifty percent of the coconut trees on Guam have reportedly been damaged or destroyed.

Coconut rhinoceros beetle larva. Courtesy Hawaii Department of Agriculture

For More Information :

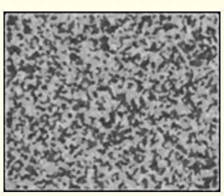
Hawaii Dept. of Agriculture http://hdoa.hawaii.gov/pi/main/crb/
USDA-APHIS http://www.aphis.usda.gov/wps/portal/aphis/home?1dmy&urile=wcm%3Apath%3A/aphis_content_library/sa_our_focus/sa_plant_health/sa_domestic_pests_and_diseases/sa_pests_and_diseases/sa_insects/sa_coconut_rhino_beetle

ILLUSTRATED GLOSSARY
Terms from Pesticide Labels
(Recertification)

Photo courtesy of cornell.edu

Clod: a lump, clump, or chunk of earth or clay

Label example: *The seedbed should be fine, firm and free of **clods** when tillage is performed* [to incorporate the herbicide into the upper 1 to 2 inches of soil].

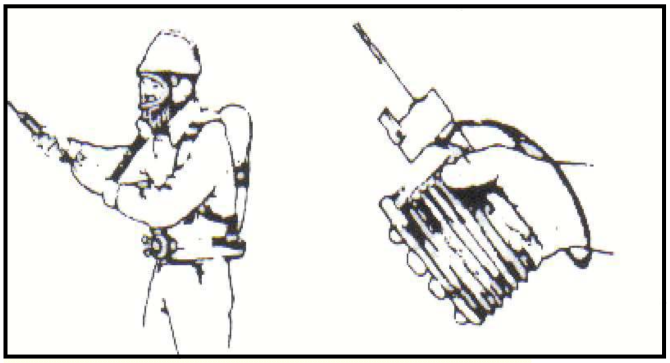


Particles forming in a solution

Particles settled in a layer at the bottom

Precipitate: small solid particles that form in a solution as a result of a chemical reaction and usually settle at the bottom in a layer

Label example: *If a compatibility agent is necessary to improve mixing or to prevent the formation of undesirable and unsprayable gels or **precipitates**, while agitating add it to the carrier* [liquid fertilizer] *in the tank.*



Using a direct reading detection device

Image from page 7 in Fumigation Training Manual, *prepared by Lorraine D. Rodriquez, University of Kentucky, College of Agriculture, Cooperative Extension Service, as viewed on 12/26/2014 at http://pest.ca.uky.edu/PSEP/Manuals/7c-FumigationManual.pdf.*

Direct reading detection device: An air-sampling device used to measure the concentration of a toxic gas in the air at a fumigation site.

Label example: *If the air concentration level* [of chloropicrin] *exceeds 4 ppm, an air supplying respirator must be worn. The air concentration level is measured by a* ***direct reading detection device****, certified for chloropicrin use, such as a Matheson-Kitagawa or a Dräger tube/pump.*

Dräger colorimetric tube and pump gas collector

Image from page 49 in Soil Fumigation Manual, *by Lisa A. Blecker and Jane M. Thomas. Published in 2012 by the National Association of State Departments of Agriculture Research Foundation.*

Barrier laminate glove

Image from page 2 in the leaflet Glove Selection for Working with Pesticides, *June 2012, by Frederick M. Fishel, University of Florida, as viewed on 12/26/2014 at http://edis.ifas.ufl.edu/pdffiles/PI/PI15700.pdf.*

Barrier Laminate: a multi-layer, laminated, foil-like plastic film used to make gloves or aprons worn to protect the skin from contact with harmful chemicals.

Label example: *Applicators and other handlers must wear: long-sleeved shirt and long pants, chemical-resistant gloves, such as* ***Barrier Laminate*** *or Viton ≥ 14 mils, shoes plus socks, and protective eyewear.*

The definitions in this glossary are intended to help understand the terms used on pesticide labels. Other definitions may be available for these terms.

The Pesticide Label

January–March 2014

PREVIOUS RECERTIFICATION ARTICLES

July–September 2014: Pesticide Use and Your Personal Protective Equipment (p.10), Illustrated Glossary (p.20).

April–June 2014: How to Find Bed Bugs (p.2), Protecting Children From Poison Emergencies (p. 5), Illustrated Glossary (p.18).

January–March 2014: Proper Disposal of Pesticides (p.2), Proposed Changes to Worker Protection Standard: EPA Requests Your Input (p.6), Do You Need a Permit Before Applying a Pesticide to "State Waters" of Hawaii? (p.10), Illustrated Glossary (p.16).

July–September 2013: Application of IPM Principles to Structural Pests (p. 2), How Pest Treatments Fail (p. 6), Restricted Use Pesticides Require an Extra Level of Care (p. 12)), Illustrated Glossary (p.16).

January–June 2013: Bedbugs and Pesticide Misuse (p. 2), Maintaining Personal Protective Equipment (p. 7), Diluting Pesticides (p. 11), Illustrated Glossary (p.14).

September–December 2012: Recordkeeping for Restricted Use Pesticides (p.2), Pesticide Decisions: Preapplication Checklist (p.9), Plant Diseases Caused by Living and Non-living Factors (p.15), Illustrated Glossary (p.20).

April–August 2012: Pesticides, EPA, and the Endangered Species Act (p. 2), Pesticide Decisions: Safety Checklist (p. 7), Choosing Pesticides for Greenhouses and Nurseries (p.12), Illustrated Glossary (p.15).

Archived issues of "The Pesticide Label" available for free download at
http://pestworld.stjohn.hawaii.edu/pat/Newsletter_main.html

If you would like us to send you an e-mail when a new issue has been posted, send your request to charlie@hpirs.stjohn.hawaii.edu with "new issue alerts" as the subject.

This newsletter is published by the Extension Pesticide Programs. For information on pesticide programs, please contact:

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E-mail: cynagami@hawaii.edu
Web: http://pestworld.stjohn.hawaii.edu/pat/newsletter_main.htm

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