

VTPP Quarterly

A Newsletter From Virginia Tech Pesticide Programs

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Pesticide Toxicity: A Review

Daniel Frank – Director, VTPP

Pesticides, by their inherent nature, have properties that make them toxic to certain organisms. Toxicity refers to the degree in which a chemical substance, or mixture of chemical substances, can harm an organism. Every chemical substance has some level of toxicity; even water can be toxic when given in a large enough dose. Understanding pesticide toxicity will help you select products that pose the least risk to your health, yet still meet your pest management needs.

Toxicity is measured for both short-term (acute) and long-term (chronic) exposure. The toxicity of a pesticide product depends on the type and amount of active ingredient(s) as well as inert (other) ingredients contained in the product.

Acute Toxicity

Acute toxicity is the measure of harm caused by a single pesticide exposure. The most common way acute toxicity is measured is through experimental tests that determine a pesticide's LD₅₀ (lethal dose 50%). This is the amount of an ingested or

dermally applied substance (single dose) that causes the death of 50% of a group of test animals. The LD₅₀ is expressed in milligrams of chemical per kilogram of body weight (mg/kg). The lower the LD₅₀, the more toxic the chemical. For example, a chemical with an LD₅₀ of 5 mg/kg is far more toxic than a chemical that has an LD₅₀ of 5000 mg/kg. Another common measure of acute toxicity is LC₅₀ (lethal concentration 50%), which refers to the concentration of a chemical in air and is usually determined for a specific exposure period (e.g., inhalation for 4 hrs.).

The LD₅₀ and LC₅₀ are used to determine a pesticide's signal word. The Environmental Protection Agency (EPA) requires signal words to be printed in capital letters on the front page of all pesticide labels to alert you to how acutely toxic each product is to humans. Signal words include CAUTION, WARNING, and DANGER (or DANGER-POISON). Table 1 presents the relation of each signal word to the approximate lethal dose of a substance in adult humans. Toxicological information (including LD₅₀ and LC₅₀ data) of a pesticide product can be found in its safety data sheet (SDS).

Signal Word	LD ₅₀ Oral (mg/kg)	LD ₅₀ Dermal (mg/kg)	LC ₅₀ Inhalation (mg/L)	Lethal Dose*
DANGER (DANGER-POISON)	Trace to 50	Trace to 200	Trace to 0.2	A few drops to 1 tsp.
WARNING	50 to 500	200 to 2,000	0.2 to 2	1 tsp. to 1 oz.
CAUTION	> 500	> 2,000	> 2	> 1 oz.

*Approximate value based on average size adult weighing 180 lbs.

Table 1. The relationship between the toxicity of a pesticide and its assigned signal word.

Although toxicity studies help estimate the risk that a pesticide may cause harmful effects in humans, some people may react more or less severely than others. It should also be understood that children can be much more vulnerable to pesticide poisonings because of their smaller size and weight, and their different biological susceptibility.

Chronic Toxicity

Chronic toxicity is the measure of harm caused by repeated exposure to small doses of pesticide over a prolonged period of time. Chronic toxicity is often determined by exposing laboratory animals to an active ingredient for several years. If the EPA determines that small exposures to a pesticide over the course of a human lifetime would cause a significant increase in the likelihood of harm (e.g., cancer, birth defects, tumor generation), then they place further restrictions on how the pesticide can be used. In many cases, the EPA opts to deny registration of a pesticide if the risks to human health are too great.

Runoff and Leaching of Pesticides

Kathleen Miller – Extension Associate

With the considerable amount of rain in much of Virginia during the late summer and fall, many soils are saturated. Such conditions can cause runoff and leaching problems for pesticide applicators.

Saturated soils allow for greater movement of water through and over soil, increasing the likelihood of pesticide movement away from application sites and into water bodies, such as streams, lakes, and groundwater. Runoff and leaching are two forms of this type of movement. Runoff is the movement of water over the soil surface, while leaching is the downward movement of water through the soil profile. Rates of runoff and leaching are typically greater at the beginning of the growing season, when pesticides are often applied at higher rates. However, runoff and leaching can be prevalent throughout the remainder of the year as well.

Causes of Pesticide Runoff and Leaching

Runoff and leaching are due to several factors and occur in both agricultural and nonagricultural settings. The main cause occurs when large amounts of water, whether through precipitation or irrigation, follow a pesticide application. Various properties of the pesticide, particularly solubility and adsorption, can influence the likelihood of runoff or leaching following a precipitation event or excessive irrigation. For instance, the ability of the pesticide to dissolve in water, known as its solubility, can determine the likelihood of it being transported by water. Pesticides with higher solubility move more easily with water. The pesticide's ability to bind or adhere to soil particles (adsorption) also impacts chances of runoff or leaching. With higher adsorption, the pesticide is less likely to leave the soil of the application site. Adsorption can be affected by the concentration of the pesticide, with higher concentrations more likely to move. Soil properties, such as permeability, texture, and organic matter content, can also affect pesticide adsorption. Pesticides are typically less likely to adsorb to permeable, coarse-textured soils with low organic matter, such as sand.

Consequences of Pesticide Runoff and Leaching

Contamination of surface water or groundwater through runoff and/or leaching is the result of point source pollution (from a specific, identifiable area), or nonpoint source pollution (from a widespread area). Examples of point source pollution include back siphoning of pesticides into water supplies, pesticide spills, and improper disposal of containers, rinsate, and excess pesticides. Examples of nonpoint source pollution include erosion of pesticide-contaminated soil, and exceeding labeled use rates during broadcast applications across agricultural and nonagricultural landscapes.

All sources of pesticide pollution can have deleterious effects on the environment and human health. Pesticide runoff and leaching can harm nontarget organisms, such as plants, bees, fish, and aquatic invertebrates. Humans also fall under nontarget organisms affected, as pesticide contamination can reduce the quality of our drinking water.

Ways to Prevent Pesticide Runoff and Leaching

Risk of pesticide runoff and leaching can be mitigated through a combination of best management practices:

- Employ integrated pest management principles, such as use of nonchemical control tactics (crop rotation, biocontrol, etc.) when possible, to reduce pesticide use.
- Plant strips of vegetation along streams, rivers, or ponds (known as riparian buffers) to help protect water from pesticide contamination by reducing the flow of runoff.

- Prevent back siphoning of pesticides into water sources by using anti-backflow devices.
- Avoid applying pesticides before a rainfall event is expected, and avoid irrigating the application site shortly after pesticides have been applied (unless the label specifies otherwise).
- Use pesticides only when necessary. Do not exceed labeled rates.
- Carefully store, mix, load, and apply pesticides to avoid spills and leaks.
- Keep pesticides away from wells, storm drains, and other surface waters.
- Properly dispose of pesticides and their containers.
- Understand different aspects of your application sites, and choose techniques accordingly. Consider how the following characteristics of the site may influence pesticide leaching and runoff:
 - Proximity to nearby waterways and wells, as well as depth of water table.
 - Slope (steepness and where it leads).
 - Soil characteristics (moisture, organic matter content, texture, etc.).
 - Nearby vegetation (buffer zones).

In addition to the above, always read the pesticide label for specific information concerning environmental hazards or special restrictions. Follow any groundwater warning statements or listed setbacks between the application area and water resource. An important part of using pesticides legally and responsibly is considering where pesticides end up after they are applied.

Blast From the Past

Stephanie Blevins Wycoff – Extension Associate

Blizzard Powder Gun (Hand Duster)

The photo below (fig. 1) shows a hand duster known as the Blizzard Powder Gun that was trademarked by the Thos. W. Houchin Co. in 1889. This hand duster was used to control insects in the house and garden. Although not shown here, an opening underneath the container allowed for insecticide powders to be loaded into the duster. The applicator would then squeeze the center of the duster to apply various insecticide powders.



Figure 1. Blizzard Powder Gun, 1889.

Program Updates

VTPP Update

For the 2022-23 private applicator recertification (PAR) season, VTPP will be managing a PAR online course for interested Virginia private pesticide applicators. We are very grateful to the VCE agents that have assisted us with online private applicator recertification during the COVID-19 pandemic. Fortunately, the number of private applicators now seeking online certification has decreased significantly, and VTPP is happy to be able to again resume full responsibility for this task.

The 2022-23 PAR online course will give private pesticide applicators full credit in Categories 90 and 91 if completed. Each user enrolling in the course must have their own, unique email address. Recertification credits can only be provided to a single individual registered under that email address (only one registrant per email address — no duplicate email address usage). Access to the course will be given through an emailed VCE Canvas guest account invitation following registration and confirmation of enrollment.

The PAR online course enrollment information is below:

- Link: tinyurl.com/VCE-VTPP-PAR-90-91.
- Title: VTPP-PAR-01-2022 Online Private Pesticide Applicator Recertification.
- Cost: \$30.
- Enrollment period: Oct. 1, 2022 – Feb. 20, 2023.
- Deadline to complete the course: Feb. 28, 2023.

No extensions will be given. Applicators with certificates that expire on Dec. 31, 2022, will have to re-test if they do not complete a recertification course before March 1, 2023.

The public can also find the registration on register.ext.vt.edu/ by searching under “Programs” and then under “Agriculture” or “Natural Resources” or by using specific keywords (e.g., pesticide, applicator, private, recertification, PAR, private applicator, VTPP, Category 90, Category 91). For guest account issues, please contact Traci McCoy (tсмccoy@vt.edu), and copy Stephanie Collins (collinss@vt.edu) and Patty Taylor (ptaylor1@vt.edu). For questions about course content, please contact Rachel Parson (rparson@vt.edu).

VDACS Update

NEW Online Certification System

The Virginia Department of Consumer Services (VDACS), Office of Pesticide Services (OPS) has launched a new online certification system for pesticide applicators. Using the online system can potentially reduce the overall processing time, eliminate postage costs, and enable easy online

payments for both prospective and currently certified pesticide applicators. While the current process of sending paper copies remains an option, applicators now may also complete and submit an application and the corresponding fee to become a certified applicator, via the online portal. They may also have their certification reinstated, add a category, and submit change of information forms and all other related activities online. Applicators electing to use the online system will receive their Letters of Authorization to test, applicator certificates, and other similar correspondence electronically. Applicators electing to continue to use the paper-based process will continue to have any Letters of Authorization to test, applicator certificates, and other correspondence sent via regular mail. All applications and other submissions will continue to be processed based on the date of receipt by OPS. This includes both paper and online submissions.

Interested applicators may access the [online portal](#).

Once on the “Online Registration Landing Page,” select the link under the “Pesticide Applicator Certification” header to go to the “Online Certified Pesticide Applicator Page.” Further instructions are provided online for assistance at each step:

- Tokens were included in the renewal letters sent to applicators whose certificates had an expiration date of June 30, 2022. The tokens in the renewal letter expire November 30, 2022*. If an applicator received a token, but has not set up their account, they should select the link under the heading “If you have received a renewal letter to get access to your historical records” to enter their token. The token is only used for the initial account set up. After entering the token, the applicator will be able to create a username and password. They will use the username and password for future access to the account. Applicators who have set up a username and password will access their account using the link under the heading “If you have previously created your login account.”

**When a token has expired, applicators will need to follow the steps provided below for current or previously certified applicators who do not have a token.*

- Applicators who are currently certified, were previously certified, or previously applied to take an exam that wish to access their records online but do not have a token should send an email requesting access to opsclrt.vdacs@vdacs.virginia.gov. In the email request, include the applicator’s email address that will be used to access the user’s account and used for future correspondence. An invitation to the account will be sent to the specified email with a link to create the account. No token should be required.

- Prospective applicators (applicators who have not previously submitted an application to take an exam and are not certified) can create an account without a token. Select the link under “If you have never previously submitted a pesticide applicator form” to set up your account.

Questions about the new online certification system can be sent to opsclrt.vdacs@vdacs.virginia.gov.

Option for Remote Testing Coming Soon

VDACS-OPS will soon introduce the option of fee-based online pesticide certification exams through a partnership with Everblue. Using Everblue’s proprietary registration and test delivery system, pesticide certification candidates will be able to register online for their pesticide exam and will be immediately enrolled into their on-demand tests. After doing a systems check of their computer, a candidate will be able to complete their exam from home. The Everblue online testing system also includes virtual exam proctoring, scoring, and the ability to transmit the results back to VDACS-OPS. Currently, Everblue delivers online pesticide education services for several other states, including Arkansas, Connecticut, Florida, Iowa, Massachusetts, Minnesota, North Carolina, Rhode Island, and Tennessee.