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

January–March 2016

In This Issue

RECERTIFICATION TOPICS

Other Articles

REGULATORY UPDATES

Special Local Need Registration

NEW or RENEWED since the last issue of the newsletter:

For growers of **containerized corn, soybean and sunflower being grown in greenhouses, lath or shade houses for seed and plant breeding research programs**—use of the pesticide **Marathon® Greenhouse and Nursery Insecticide** (OPH, Inc.; EPA Reg. No. **59807-15**)—requires having a copy of **HI-160001**, which is valid 2/12/2016–2/11/2021—Note: The Worker Protection Standard rules apply because this product is an agricultural use pesticide.

For managers of **forested areas**—use of the pesticide **Leaf Life® Sluggo® Slug and Snail Bait** (Loveland Products; **67702–3–34704**) for controlling non-native slugs and snails in forested areas for conservation purposes—requires having a copy of **HI-100004**, which is valid 10/28/2015–10/27/2020—Some notes: • Area must be thoroughly searched by experienced malacologists during the day and at least one night prior to application to ensure that non-target endemic Hawaiian snail species are not impacted. • Do not apply within 20 m of known populations of endemic Hawaiian snail species from the following rare families or subfamilies: Amastridae, Achatinellinae and Endodontidae. • Report any evidence of suspected poisoning of Hawaiian snails to the Pesticides Branch of the Hawaii Department of Agriculture, phone: (808) 973-9401.

For managers of **forested areas**—use of the pesticide **First Choice® Sluggo® Slug and Snail Bait** (Loveland Products; **67702–3–34704**) for controlling non-native slugs and snails in forested areas for conservation purposes—requires having a copy of **HI-100004**, which is valid 10/28/2015–10/27/2020—Some notes: • Area must be thoroughly searched by experienced malacologists during the day and at least one night prior to application to ensure that non-target endemic Hawaiian snail species are not impacted. • Do not apply within 20 m of known populations of endemic Hawaiian snail species from the following rare families or subfamilies: Amastridae, Achatinellinae and Endodontidae. • Report any evidence of suspected poisoning of Hawaiian snails to the Pesticides Branch of the Hawaii Department of Agriculture, phone: (808) 973-9401.

EXPIRED or EXPIRING January 1–June 30, 2016

EPA SLN Number **HI-100003**, for the product **Merit 1 G Greenhouse and Nursery Insecticide**, with EPA Reg. No. **432-1329**, to treat containerized corn, soybean, and sunflower grown for seed in plant breeding research programs, expired **2/7/2016**.

EPA SLN Number **HI-000005**, for the product **Dibrom Concentrate**, with EPA Reg. No. **5481-480**, for use in or on plastic bait traps, fiberboard blocks, or similar dispensers, telephone or light poles or other inanimate objects, nonfood tree trunks or limbs, expires **4/20/2016**.

RECERTIFICATION CREDITS may be earned by certified applicators who score at least 70% on the set of comprehension evaluation questions about the "recertification" articles in this newsletter. These articles have a title followed by "(recertification)." However, credits may not necessarily apply to the following categories: Private 2, Private 3, Commercial 7f, and Commercial 11. The questions are written and administered by the Hawaii Department of Agriculture staff. To ask about earning recertification credits, call one of these phone numbers:

Kauai applicators—Call the Honolulu office, either directly: (808) 973-9409 or (808) 973-9411, or through the Kauai State Toll Free Access number: 274-3141 and then enter extension 39409 or 39411 followed by "#."

Oahu applicators—Call the Honolulu office directly: (808) 973-9409 or (808) 973-9411.

Maui, Molokai, or Lanai applicators—Call the Honolulu office, either directly (808) 973-9409 or (808) 973-9411; or through the Maui State Toll Free Access number: 984-2400 and then enter extension 39409 or 39424 followed by "#."

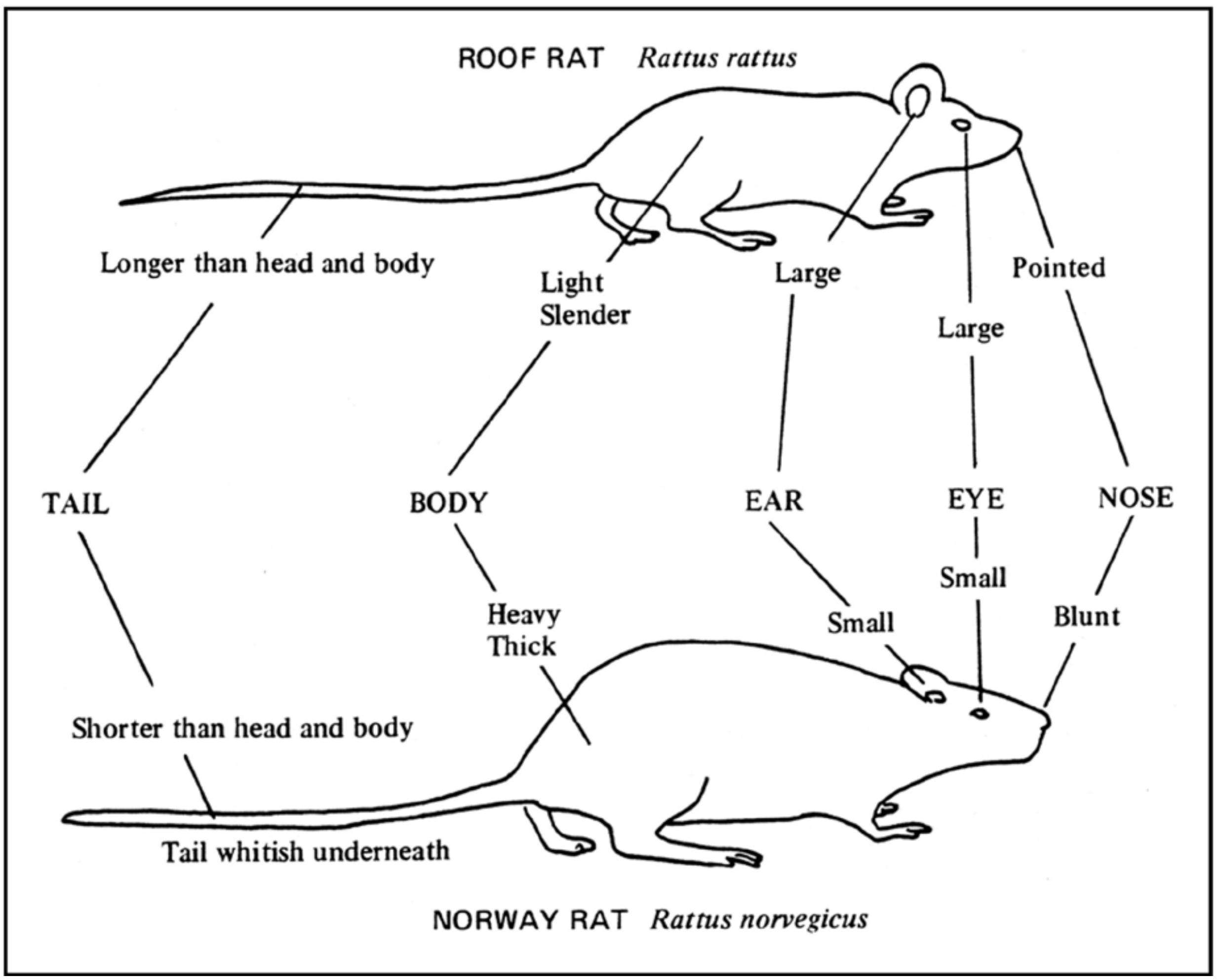
Hawaii island applicators—Call the Hilo office directly: (808) 974-4143 or (808) 333-2844.

630 US ISSN 0271-9916 NOVEMBER, 1980 RESEARCH-EXTENSION SERIES 002

RODENTS AND RODENT CONTROL IN HAWAII

Barry M. Brennan

University of Hawaii at Manoa
HAWAII INSTITUTE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES



RODENTS AND RODENT CONTROL IN HAWAII

(recertification)

By Barry M. Brennan

The rat and its cousin, the mouse, have been important pests to man since ancient times. They are especially important as disease carriers. They also cause enormous destruction and loss of food and property. Their control is not easy due to their ability to adapt to changes and their capacity to reproduce.

Rodents are carriers of a number of important diseases including plague, murine typhus, leptospirosis, and salmonellosis. The Hamakua coast area on the Big Island and Makawao district on Maui were former plague endemic areas, but the last reported human case occurred in 1949 (Hamakua). However, plague is still kept under surveillance by the Department of Health Vector Control Program. Although murine typhus and leptospirosis are known to occur throughout the islands, only sporadic cases have been reported.

Rodents consume, contaminate, and cause extensive damage to food and agricultural crops. For every $2 worth of food they eat, they cause $20 worth of damage. In Hawaii, state and private agencies spend more than $600,000 annually to control rodents.

There are four rodents of economic importance in Hawaii: the roof or black rat, the Norway or brown rat, the Polynesian (Hawaiian) rat, and the house or field mouse. The roof rat is found in agricultural areas, wooded gulches, kiawe forests, and in both wet and dry forests. This species has displaced the Norway rat as the most common rat found close to human habitations and especially in wet areas such as stream beds, drainage canals, and sewers. The Polynesian rat is the smallest of the three rats and it apparently prefers agricultural lands, range, and wooded areas (including gulches) up to 2,500 feet. Like the Norway rat, it may cause considerable damage to cane. The house mouse is smaller than the rats and is found both in urban and rural areas. On Maui, Hawaii, and Oahu, there have been cyclic mouse "outbreaks" every few years. The cause is not wholly known but is probably related to an abundance of food and shelter before and during the critical breeding cycle, followed by disappearance of these essentials with the onset of drought conditions, which forces the migration of mouse populations.

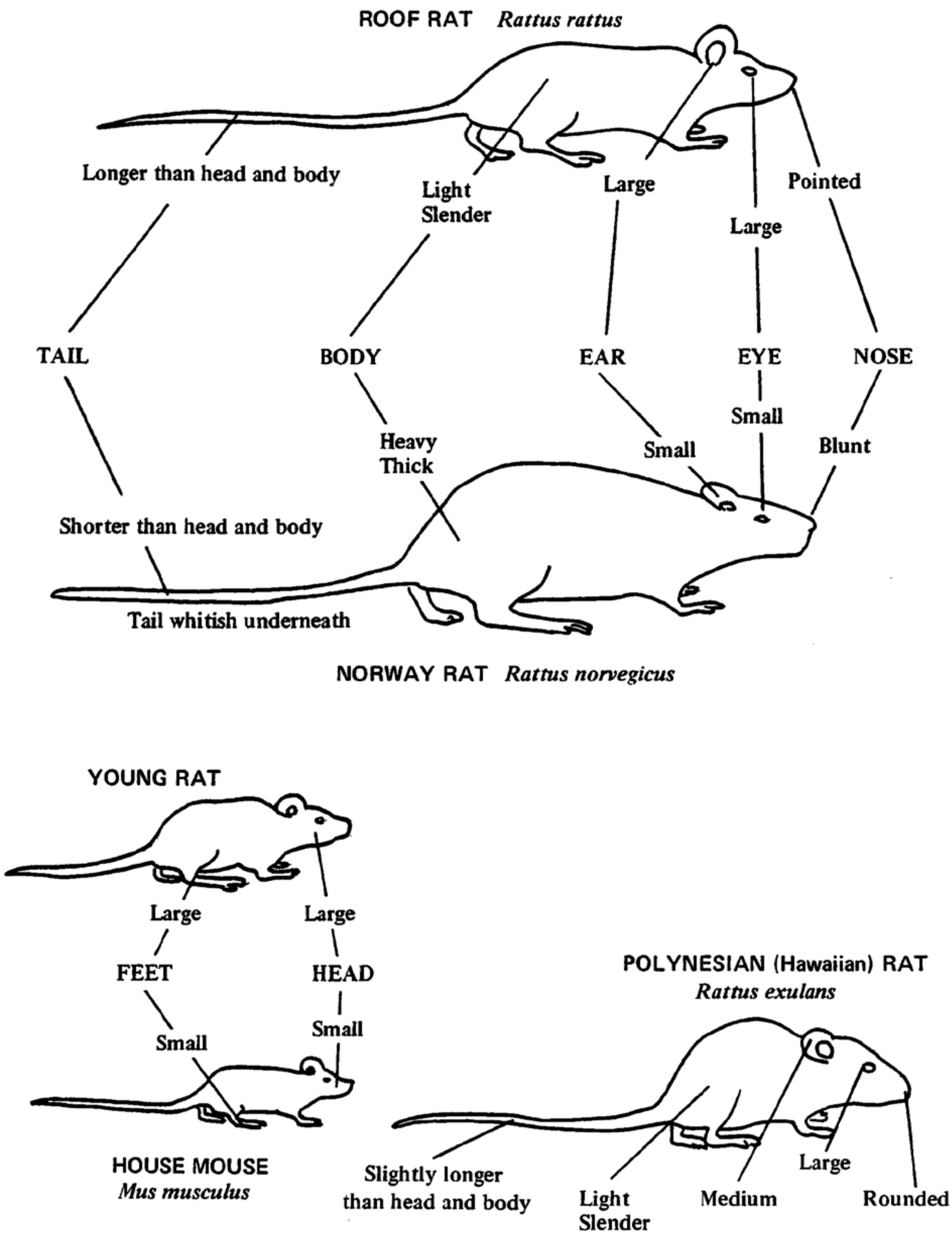
IDENTIFICATION OF RODENTS (see diagram page 4)

Roof rat (*Rattus rattus*)—Medium to large rat, body 5 to 7 inches long. Tail slender and always longer than head and body combined. Body color varies from gray to jet black; underside gray, gray white, or white. Nose sharply pointed, large eyes, large, thin ears; in female, five pairs of nipples. Expert climber and wire scaler; frequents cane fields macadamia nut, coffee, papaya, and banana groves; nests in attics of buildings, trees, banana bunches, and abandoned burrows of Norway rat. Moderately susceptible to plague infection.

Norway rat (*Rattus norvegicus*) —Largest of rats in Hawaii, weighs 10 to 18 ounces, measures 8 to 10 inches long. Tail stout, shorter than head and body combined. Body color reddish brown to gray to black; underside whitish color. Head wide, nose blunt, ears small, eyes small, chunky in appearance; in female six pairs of nipples. A burrowing species in ground, rubbish piles, garbage dumps, and under walks and docks; frequents sewers, pigsties, and chicken coops. May cause great damage to cane fields. Vicious, High degree of resistance to plague infection.

(continued on page 6)

Identifying Rats and Mice



Polynesian rat (*Rattus exulans*) —Comparatively small in size, weighs 2 to 3 ounces, measures 4 to 5 inches long. Tail as long as or slightly longer than head and body combined; bristles along tail give the appearance of faint, narrow rings. Body color is cinnamon brown to cinnamon buff to gray; stiff black guard hairs on back and sides; underside light buff or gray. Nose roundly pointed, ears rather short, eyes medium size, hind feet dark on underside; in female, four pairs of nipples. A field rat, rarely found near buildings in Hawaii; nests in burrows, gulches, rock piles, rock walls, wastelands, fields, and embankments. Causes great damage to sugarcane, pineapple, macadamia nuts, coconuts, coffee, and other fruit and vegetable crops. Very susceptible to plague infection.

House mouse (*Mus musculus*) —Smallest of the four rodent species, weighs about ½ ounce, measures 6 to 7 inches long from nose to tip of tail. Slender tail as long as or longer than head and body combined. Body color varies from yellowish dirty tan to dusky gray, darker over back, lighter underneath. Body slender, ears large, eyes small, nose pointed; in female, five pairs of nipples. Nests in any type of shelter, inside buildings, rock walls, rock piles, under boards, in burrows, under cane plants, and in truck-crop fields. Damage may be extensive to truck crops, flowers, etc. Degree of resistance to plague in Hawaii has not been determined.

RAT BIOLOGY

The rat is prolific. The young rat is sexually mature at four months. Sexual activity and reproductive potential are continuous until death. Rat behavior is influenced by thirst, hunger, sex, maternal instinct, and curiosity. Rats cannot go without water for more than 48 hours or without food for more than four days. Thirsty or hungry rats become desperate and are therefore easier to control because they are less wary. Judicious use of traps, poisons, and other control measures thus become doubly effective. Rats are nocturnal and tend to develop behavior patterns which become habitual. They have a keen sense of smell and hearing, and a fair sense of sight with ability to see in the dark.

RODENT CONTROL

Rodent control is dependent upon recognition of a rodent infestation. The most common signs are droppings, rubmarks, runways, tracks, gnawings, live or dead rats, nests, and rodent odors. Control programs must be aimed at controlling the entire population, not individual rodents. Programs must include a survey to: (1) identify the species causing the problem, (2) determine the approximate size of the population, and (3) identify the characteristics of the infected area.

Rodents establish a home range which provides food, water, shelter, and reasonable protection from predators. Cleaning up the environment by removing access to food, water, or shelter, or limiting their accessibility with physical barriers such as screens, will result in a population decline. Mechanical control achieved with the use of traps may also be important. Physical, mechanical, and environmental control should be used in conjunction with chemical control.

Rodenticides are the most effective means of controlling large and small rodent populations. However, their use entails hazards to other mammalian life, including man (especially small children), pets, and domestic animals. Some poisons have a secondary effect which may affect animals which consume dead or nearly dead rodents. Thus, it is imperative that strict safety precautions be used in the preparation, broadcast, or placement and disposal of poison baits for rodents.

Rodenticides are broadly categorized as either multi-dose or single-dose poisons. Multi-dose poisons act as sub-acute rodenticides and require repeated exposures. Rodents generally do not develop “bait shyness” to anti-coagulants. The more common sub-acute rodenticides in use are warfarin (warfacide), prolin, fumarin, pival, and diphacin.

Single-dose rodenticides act as acute poisons and include red squill and zinc phosphide. Zinc phosphide has a pungent odor which repels pets and birds, but is attractive to rodents. Although these poisons are very effective when used properly, their toxicity and physical characteristics often place limits on their use.

After conducting a thorough rodent survey, pre-poisoning bait trials should be conducted to determine which foods and baits are most desirable to the rodent. This information and the type and location of bait containers must be recorded throughout the course of the control program. After two days of negative feeding, the bait stations should be removed and records reviewed.

The survey should be repeated in about two months, the approximate interval for a second generation. Properly utilized environmental and physical controls will prevent rapid infestation and population build-up.

Currently Licensed Rodenticides (active ingredients) in Hawaii

First-generation or multiple-dose anticoagulants
- Diphacinone
- Chlorophacinone

Second-generation or single-dose anticoagulants
- Brodifacoum
- Difethalone
- Bromadiolone

Non-anticoagulant compounds
- Zinc phosphide
- Bromethalin
- Cholecalciferol

Accessed 19 February 2016 at http://npirspublic.ceris.purdue.edu/state/state_menu.aspx?state=HI

Reference

1. Watanabe, Walter. Rodents. In: Vector Control Training Manual, Chapter XIV. 1975

The original article by Barry Brennan was published in November 1980 by the University of Hawaii at Manoa, Hawaii Institute of Tropical Agriculture and Human Resources, Research-Extension Series 002. The article is available at http://pestworld.stjohn.hawaii.edu/studypackets/Rodents.pdf

Further Reading:

“Rodents: Rats and Mice” published by the State of Hawaii, Department of Health, Vector Control Section. Viewed 3/16/16 at http://health.hawaii.gov/san/files/2014/04/rodent-standard-vc-format-with-photo-credits-edit-04012014.pdf.

“Rodenticides topic fact sheet” published by the National Pesticide Information Center. Viewed 3/23/16 at http://npic.orst.edu/factsheets/rodenticides.html.

“Vertebrate Pests” (chapter 8 in Public-Health Pesticide Applicator Training Manual for the USA and Its Territories). University of Florida’s Entomology and Nematology Department and the American Mosquito Control Association. Viewed 3/16/16 at http://entnemdept.ufl.edu/fasulo/vector/manual.htm.

SELECTING A PREFILTER FOR YOUR RESPIRATOR
(recertification)

In the Illustrated Glossary of our April–December 2015 newsletter http://pestworld.stjohn.hawaii.edu/pat/newsletter_main.html, we defined three parts of air-purifying respirators: the pre-filter and the cartridge or canister. This article discusses which particulate respirator or pre-filter to use when applying various pesticides.

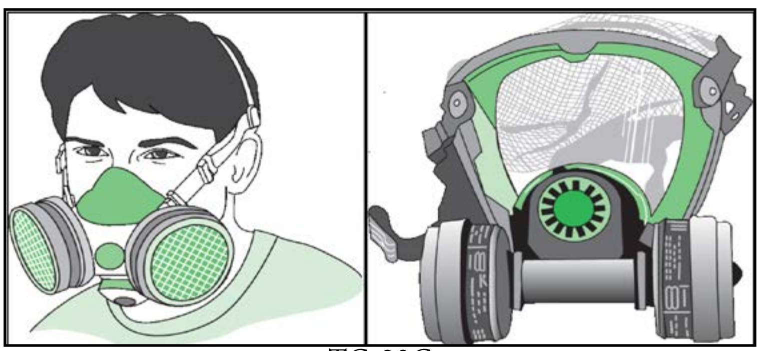
Before applying a pesticide, always read the product label. It will state the personal protective equipment required, including the type of respirator and pre-filter, if needed. The following example is from an insecticide containing methanol.

> *For exposures in enclosed areas, a respirator with either an organic vapor-removing cartridge with a* ***pre-filter*** *approved for pesticides . . . or a canister approved for pesticides . . . or NIOSH-approved respirator with an organic vapor cartridge, or canister with any R, P, or HE* ***pre-filter****.*

Respirators are certified for use by the National Institute of Occupational Safety and Health (NIOSH). NIOSH-approved masks are designated with the letters "TC," as in these three commonly used respirators.

- TC-84A: disposable particulate or "dust mask" respirators
- TC-23C: chemical cartridge respirators
- TC-14G: canister or "gas mask" respirators


TC-84A


TC-23C


TC-14G

An N95 pre-filter blocks 95% of solid and liquid particles, but is not oil resistant or oil proof.

Pre-filters, disposable particulate respirators, and filters trap solid or liquid particles before they reach the chemical cartridge. Pre-filters and particulate respirators are designated by their filtering efficiency and resistance to oil. Filtering efficiency is the percentage of the particles trapped: 95, 99, or 100 percent.

Oil resistance is designated by the letters N for "Not resistant" to oil, R for "Resistant" to oil, P for "Oil proof," and HE or "High Efficiency" filters for powered-air purifying respirators. If you are applying an oil-based pesticide, use an R, P, or HE pre-filter. A

A P100 pre-filter blocks all solid and liquid particles and is oil proof.

P100 pre-filter, for example, would trap all dust and mist particles and be oil proof.

Gases or vapors require a cartridge-type respirator such as a TC-23C facemask respirator or TC-14G canister respirator. These cartridges remove toxic gases or vapors that pass through the pre-filter. Cartridges or canisters are universally color coded:

White	White: Acid gas
Black	Black: Organic vapors: pesticides, paint spray, and fumigants if allowed by the label
Green	Green: Ammonia, either anhydrous of from confined livestock
Yellow	Yellow: Acid gases like chlorine and other disinfectants, plus organic vapor
Olive	Olive: Numerous gases and vapors
Purple	Purple: Any particulates (P100)

In summary, if you are spraying a pesticide, you will probably need a pre-filter. An N95 is good for filtering most particles and is the most freqently used. If highly toxic material such as lead or asbestos are present, however, an N100 or P100 are needed for the best protection. If the pesticide is oil based, use an R, P, or high-efficiency (HE) filter.

This article is based on the "Respirator Selection Guide" distributed by Gempler's®. The guide is available at http://www.gemplers.com/tech/sresp.htm

For more information

OSHA guide https://www.osha.gov/dts/shib/respiratory_protection_bulletin_2011.html

Respirators for Pesticide Applications https://edis.ifas.ufl.edu/pi114#FIGURE%204

Respiratory protection http://mathesongas.com/industrialgas/pdfs/safety/respiratory.pdf

Counterfeit and Altered Resporators https://www.youtube.com/watch?v=SyOSfAHh4ao

PESTICIDE SHELF LIFE

(recertification)

Pesticides in general are manufactured, formulated, and packaged to specific standards. When stored improperly, however, they can break down, especially under conditions of high temperature and humidity.
Dry formulations such as wettable powders (WP), soluble powders (SP), water-dispersible granules (WDG), and granular (G) formulations can become caked and compacted. Emulsifiable concentrates (EC) can lose their ability to form emulsions. Some pesticides actually become more toxic, flammable, or explosive as they break down.

Pesticide formulations that contain low concentrations of active ingredients generally lose effectiveness faster than more concentrated forms. Sometimes a liquid pesticide develops a gas as it deteriorates, making opening and handling containers quite hazardous. Certain pesticides have a characteristic odor. A strong odor in the storage area may indicate a leak, a spill, or an improperly sealed container. An odor may also be a clue that the pesticide is deteriorating, because the smell of some chemicals intensifies as they break down. If none of these problems is found, chemical odors can be reduced with exhaust fans or by lowering the temperature of the storage area.

Washington State Department of Agriculture

Improper storage of chemicals sometimes can be detected by an odor, or signs of a spill or leakage. Photo Washington State Department of Agriculture

Pesticide containers, including fiber and metal drums, pails, cans, bottles, bags, boxes, over-packs, and liners, have an important effect on storage and shelf life. If stored for long periods, these containers may eventually corrode, crack, break, tear, or fail to seal properly. The label may become illegible as well.
If a pesticide container needs to be replaced, transfer the pesticide to another container of the same type, such as a polyethylene jug, a thick paper bag, or a brown glass bottle. With plastic jugs, try to find a jug made of the same type of plastic. You can at least get a jug from the same group of plastics by checking the recycling number on the bottom of the jug and using a replacement jug with the same number. Obtain a replacement label from your pesticide dealer to put on the new container.

Moisture, high humidity, and long storage can damage boxes and bags, corrode cans and drums, and make pesticide labels unreadable. Photo University of Kentucky, Occupational Health and Safety

If stored in a cool, dry area that is out of direct sunlight, pesticides will generally have an extended shelf life. Protection from temperature extremes is important because heat or cold can shorten a pesticide's shelf life. At temperatures below freezing, some liquid formulations separate into their various components and lose their effectiveness. High temperatures cause many pesticides to volatize or break down more rapidly. Extreme heat may also cause glass bottles to break or explode.

One way to ensure that you avoid problems with shelf life or storage is to only buy what is needed for one season. Buying more pesticide than is necessary because of reduced case lot prices or a sale may become more expensive in the long run, when it comes to disposing of excess pesticide.

Air conditioning and ventilation will help protect pesticides and their containers from damage due to high temperatures. Photo U.S. Chemical Storage

Before storing chemicals, read the label and follow any specific guidelines listed. Store different groups of pesticides, such as herbicides, insecticides, and fungicides, in separate locations in the storage area. This will help prevent cross-contamination from fumes and vapors as well as accidental use of the wrong type of pesticide. Never store chemicals near any type of animal feed. Always store chemicals out of the reach of children, preferably in a locked cabinet or room in which only pesticides are stored. Store personal protective equipment, such as gloves, goggles, aprons, and respirators, in another clean, dry location away from pesticide fumes.

This article, slightly modified, was published in the Illinois Pesticide Review newsletter in May, 2008. An archived copy is available at http://web.extension.illinois.edu/ipr/i5098_829.html#71681

PESTICIDE STORAGE AND SECURITY

(recertification)

Proper storage is important for keeping pesticides in good condition for use the following year, as well as for keeping children and unauthorized people from tampering with these products. Pesticides should not be exposed to temperatures over 110°F, or breakdown and loss of effectiveness can occur. Also, check the pesticide label to see if you should guard against freezing temperatures. Store your herbicides separately from insecticides, fungicides, and other pesticides to avoid their contamination from herbicide fumes.

Pesticides should be kept locked up except when in use. Even when you remove a container of pesticide for use, you should keep the storage area locked while mixing and loading the sprayer, spreader, or other application equipment. Even if the storage area is in sight of the mixing and loading area, you may be called away to the phone or to assist someone else. Just a few minutes' absence can be enough for a child or another person to find the storage area and become poisoned. Given today's concern about terrorism, consider that an unauthorized person entering the area may be more than a curious passerby. Sprayers, spreaders, and other pesticide application equipment should also be kept locked up and secured to protect it from tampering and accidents. Be especially watchful and suspicious of unauthorized people in these areas.

Image compliancesigns.com

In addition to being kept locked, the pesticide storage area should be plainly labeled as such. A sign stating "Danger-Pesticides-Keep Out" or similar information should be appropriate. If you have Hispanic employees who do not read English, then the warning should also be in Spanish, or other appropriate language. A list of stored pesticides should be kept in your office and with the local fire department. There should also be a map or other information indicating which particular building and part of the building contain pesticides. This information can be useful to the fire department for the protection of firefighters, as well as for avoiding environmental contamination from pesticide being carried away with water used to fight the fire.

Near the pesticide storage area, there should be soap and water for washing pesticide off your hands or other skin areas. Maintain an eyewash station, or at least have a faucet or hose if pesticide splashes into the eye. First aid for eye exposure to many pesticides is to wash the eyes with running water for at least 15 minutes.

Have a fire extinguisher handy because some pesticides are flammable. An absorbent material should be available for liquid pesticide spills. This may be sawdust, kitty litter, oil dry, or specialized absorbent pads or "snakes" to surround and contain spills. NOTE: sawdust is a potential fire hazard if used to absorb a pesticide that is a strong oxidizer (check the label or SDS). Have a broom, dustpan, and trash can to pick up and store any dry spills or absorbed liquid spills until they can be disposed of properly. Pesticide labels have a telephone number to contact the pesticide company on the proper method to dispose of spilled pesticide. Local emergency personnel at fire and police departments can also provide assistance.

SAMPLE SPILL KIT

- **Emergency phone numbers**
- **Personal protective equipment (chemical-resistant gloves, coveralls or apron, boots; splash goggles, respirator**
- **Containment "snakes" or tubes to confine the spill**
- **Absorbent clay, pet litter, spill pillows, vermiculite, etc.**
- **Spray bottle with water to mist dry spills, or plastic to cover them**
- **Warning sign and/ or barricade tape**
- **Broom, dustpan, shovel**
- **Heavy-duty plastic bags and ties**
- **Duct tape—many possible uses**
- **Large plastic container with lid to handle all bagged spillage; can also be used to store spill kit**

–From lists by Penn State and University of Florida Extension Services

Use the following checklist to improve the safety and security of your facility and pesticide storage area:

- For safety reasons, label your pesticide storage building with a sign stating "Danger-Pesticides-Keep Out," and post a list of emergency contacts at the main entrance to the storage area. Include the names, addresses, and phone numbers of at least two key employees, and the phone numbers for the police and the fire departments. In addition, "Emergency: Dial 911" and the Rocky Mountain Poison and Drug Center (1-800-222-1222) should also be listed.
- Keep inventory records of pesticides up-to-date and easily accessible. A current inventory list and map clearly showing which building(s) or parts of buildings contain pesticides should be kept with the fire department in case there is a fire at your facility.
- Have a complete label and Safety Data Sheet (SDS) for every product on the premises.
- Ensure pesticide storage areas are locked and secured when unattended and strictly limit access to storage areas by limiting and tracking who has keys.
- Storage areas should be well lighted and sturdy so any attempt to force entry requires a substantial effort that likely would be noticed and reported. To enhance security, provide adequate outside lighting and consider using a surveillance system or security service.
- Block ramps and driveways at night and disable forklifts and other equipment that could be used during a theft. Secure application equipment to prevent sabotage, theft, and misuse. Inspect storage areas and equip-

ment regularly.

- Be alert to strangers that loiter around the facility asking unusual questions and also to purchasers who:
  - –seem unfamiliar with details of using a pesticide (casually ask them a few pest or pesticide-use questions), act nervous, seem uneasy or vague, and avoid eye contact;
  - –demand immediate possession of purchased material rather than future delivery;
  - –ask for material in smaller, individual containers rather than in bulk;
  - –insist on paying with cash instead of using credit or a check.
- In addition to your regular sales records (only licensed applicators may purchase restricted-use pesticides, and the dealer is required to keep records), keep a log of suspicious persons or activities by writing down the date, suspicious activity, a physical description of the person, license plate number, and vehicle description. In the event of a theft or any signs of tampering or attempts to force entry, contact the police and provide them with a copy of your log book.
- Be proactive and discuss pesticide safety, storage, and security issues with your employees.

This article by Phil Nixon and Bruce Paulsrud, slightly modified, was published in the Illinois Pesticide Review newsletter in November, 2001. It was accessed on 1 February 2016 and is available at http://web.extension.illinois.edu/ipr/i4174_829.html

For more information:

"Chemical Accident Prevention: Site Security (EPA, Feb 2000)," available online at http://www.epa.gov/sites/production/files/2013-11/documents/secale.pdf.

Spill containment: Penn State http://extension.psu.edu/pests/pesticide-education/applicators/fact-sheets/pesticide-safety/how-to-handle-chemical-spills; University of Florida https://edis.ifas.ufl.edu/pi196

ISSUES WITH "LEAST TOXIC PESTICIDES" AND APPLIED AS "LAST RESORT"

This article, downloaded in April 2014, is available at http://www.entsoc.org/press-releases/issues-associated-least-toxic-pesticides-applied-last-resort

Lanham, MD; November 12, 2012 – Recommendations and decisions to use "least toxic pesticides" and "pesticides as a last resort" have flourished in the last decade, but according to three scientific organizations—the Weed Science Society of America (WSSA), the American Phytopathological Society (APS) and the Plant-Insect Ecosystems Section of the Entomological Society of America (P-IE ESA)—these are not the correct approaches to the pesticide component of an Integrated Pest Management (IPM) program.

The three organizations have joined to take an objective look at the problems associated with "least toxic pesticides" applied as a "last resort" and today issued the following statement:

IPM is Fundamental Wherever Pests Must Be Controlled

It is essential to practice IPM, whether managing weeds, insect pests or plant diseases—on the farm, on commercial sites, on public lands, or in or around the home. Key components of IPM include making the habitat unfavorable for pests, excluding pests where feasible, using proper sanitation practices, monitoring the infestation level, knowing the pest tolerance level for the specific situation and implementing the necessary management practices.

Judicious use of pesticides is a critical component of many IPM programs. Judicious (careful) use refers to various practices—following all label directions and making all appropriate stewardship decisions required in the particular situation. This includes applying a product registered for the target pest(s) after accurate pest identification, and consideration of the level of infestation and the potential for economic, health or other negative pest impacts. Careful use extends beyond pesticides to household chemicals, automobiles, medicines, alcoholic beverages, and countless other products that are part of our daily lives.

The Problem with Selecting Only "Least Toxic Pesticides"

- "Least toxic" implies there are pesticides available for every pest spectrum that are least toxic to everything else. This is not true. The toxicity of a pesticide depends on what is being evaluated—short-term or long-term toxicity—and who or what may be affected (e.g. applicators, farmworkers, livestock, wildlife, pets, birds, fish, beneficial insects, earthworms, sediment-dwelling organisms, crops). It is also important to remember that toxicity is not the same as risk, which is dependent on both toxicity and exposure.
- The risk associated with the use of pesticides and other chemicals is managed by establishing safe exposure levels based on the toxicity specific to each product. Assigning a "most" or "least" toxic rating does not equate to actual risk when the product is properly applied. For example, the label of a pesticide product that may cause skin irritation will also contain requirements for personal protective equipment that safeguards the skin, while a product that may affect fish will contain use directions, precautions and possibly even restrictions intended to protect fish. This is why the EPA-approved label instructions must be followed.
- All pesticides—including those referred to as "least toxic," "organic" and "natural"—are toxic to one or more pests and possibly humans and other organisms as well. Use of these terms can lead to false security regard-

ing the need for careful handling of pesticides and proper environmental stewardship.

- Over-reliance on a "least toxic" pesticide can cause new problems. For example, glyphosate is considered a "least toxic" herbicide choice, but overreliance on it has led to significant weed resistance problems. Over-use or misuse of any pest management tactic can cause problems – for example, cultivation to control weeds on hilly land can cause soil erosion, and excessive hand-hoeing can cause back injuries and increase the risk of skin cancer.
- Often, "least toxic" products do not work as well on the pest(s), leading to the need for re-treatment with another pesticide on larger and/or harder-to-control pest infestations. This can result in higher costs, reduced control and undesirable environmental effects attributable to the pest.

The Problem with Using Pesticides Only "As a Last Resort"

- "Last resort" implies that pesticides will work as well when every non-chemical control technique is attempted first. However, delaying application of a pesticide can cause buildup of the pest(s) in crops, gardens, buildings and other sites, with negative impacts on yield, quality and/or health. In fact, delaying treatment can significantly increase the ecological and economic damage to crop and non-crop areas.
- Using pesticides as the last line of defense can result in a more limited choice of pesticides, as well as reduced crop tolerance, the need for higher rates, and less effective control because of higher infestation levels and/or more tolerant pest stages. For example, seedling weeds and early-stage insect larvae and diseases are usually more easily controlled than later pest stages.
- Effective pesticide choices, when they are applied as a "last resort," means fewer options to rotate pesticides, which is a critical step in preventing a pest from becoming resistant to a pesticide. "Last resort" pesticide strategies may also increase the need for multiple products and higher application rates to control the pest effectively.
- "Last resort" suggests pesticides are always the worst choice, which is not true. First using non-chemical techniques that are ineffective or inefficient has the potential to add to the cost of pest management, intensify the pest problem or create new problems.
- Branding pesticides as the "last resort" choice certainly does not stimulate a strong public interest in funding education on their proper use. Pesticides are widely used, but discretionary federal funding of the U.S. Pesticide Safety Education Program has been eliminated in 2011 and 2012. This program is vital to educate pesticide users and dealers who must be certified to apply or sell pesticides, and to teach the public how to use pesticides safely.

There is no benefit or scientific basis to simplistic messages like "use least toxic pesticides as a last resort" for the large number of pesticide users who apply pesticides according to the label and practice good stewardship. Nor are these messages beneficial for those who neither seek training nor adequately read the label believing instead that it is safe, practical, and effective to simply choose a product considered a "least toxic pesticide" and apply it only as a "last resort." These messages hinder pesticide safety and stewardship education and practices that are in the best interest of the pesticide user, our food supply, public health and ecosystem preservation.

The WSSA, APS and P-IE ESA do not promote the use of pesticides above other pest management techniques. Pesticides should ONLY be used when needed, when risks to non-target organisms and habitats have been carefully considered, and when diligent attention will be given to following all label directions and other applicable laws. In addition, general and product-specific stewardship must always be practiced to prevent undesired effects under the particular application conditions.

Pesticides are an important component of many IPM programs for a variety of reasons. A fungicide, for example, may prevent disease, have curative effects, induce plant resistance to disease or promote plant health and yield. The most important message is to follow the label – the entire label, including all safety and other precautions – and practice good stewardship. Suggesting that only "least toxic pesticides" be used, as a "last resort," ignores the extensive research, regulatory, educational and stewardship efforts that make important pesticide tools available and define their proper and safe use in Integrated Pest Management programs.

About the Weed Science Society of America

The Weed Science Society of America, a nonprofit scientific society, was founded in 1956 to encourage and promote the development of knowledge concerning weeds and their impact on the environment. The Weed Science Society of America promotes research, education and extension outreach activities related to weeds, provides science-based information to the public and policy makers, fosters awareness of weeds and their impact on managed and natural ecosystems, and promotes cooperation among weed science organizations across the nation and around the world. For more information, visit www.wssa.net.

About the American Phytopathological Society

The American Phytopathological Society (APS) is a nonprofit, professional scientific organization. The research of the organization's more than 5,000 worldwide members advances the understanding of the science of plant pathology and its application to plant health. For more information, visit www.apsnet.org.

About the Entomological Society of America

The Entomological Society of America (ESA) is the largest organization in the world serving the professional and scientific needs of entomologists and people in related disciplines. Founded in 1889, ESA today has more than 6,000 members affiliated with educational institutions, health agencies, private industry and government. Members are researchers, teachers, extension service personnel, administrators, marketing representatives, research technicians, consultants, students and hobbyists. For more information, visit www.entsoc.org.

Scope of Illness Tied to Two Common Herbicides

Although most of the illnesses related to paraquat and diquat were low to moderately severe—health effects commonly included skin, eye, or neurological symptoms—these two herbicides make up 85 percent of herbicide-related deaths in the United States.

A NIOSH study looking at illnesses and herbicide-related deaths discovered that most cases of illness related to paraquat poisoning were low to moderately severe. According to the agency's news release, the study found 300 paraquat-related and 144 diquat-related acute illnesses were reported in 35 states and one U.S. territory; 76 percent of paraquat-related cases were work-related.

> Of the herbicide-related deaths in the 35 states and one U.S. territory between 1998 and 2011, 43 were from ingesting *paraquat*, 25 were from ingesting *diquat*.

Although most of the illnesses were low to moderately severe—health effects commonly included skin, eye, or neurological symptoms—these two herbicides make up 85 percent of herbicide-related deaths in the United States. Among the reported cases, 43 individuals had ingested paraquat and 25 ingested diquat. Most such cases were unintentional and frequently occurred because the pesticides were improperly stored, such as in beverage bottles

> "We now know that all of the cases of illness and death related to these products [*papaquat*, *diquat*] are preventable . . . ."
>
> —NIOSH Director, John Howard

"This is really the first time we've looked at the extent of illness caused by these herbicides," said NIOSH Director Dr. John Howard, M.D. "We now know that all of the cases of illness and death related to these products are preventable, which will help us identify ways to better protect both the workers who need to use these products as part of their job and others exposed to these potentially harmful chemicals."

> Sickness due to *paraquat* was mainly from not wearing PPE. With *diquat*, sickness was usually due to a failure of application equipment.

The researchers examined combined data from three sources from 1998 to 2011: the NIOSH Sentinel Event Notification System for Occupational Risks (SENSOR)-Pesticides Program; the California Department of Pesticide Regulation Pesticide Illness Surveillance Program; and the EPA Office of Pesticide Programs' Incident Data System. Other data from a national database, the National Poison Data System, was used for national trends of paraquat- and diquat-related illnesses.

Failure to wear PPE, especially eye protection, was the most common reason people became sick from paraquat, while other causes included drift from the pesticide application site and accidental spills or splashes. For diquat, the most common cause of illness was application equipment failure, followed by accidental spills or splashes. "When less harmful weed control options aren't an option, these findings suggest that additional training and stricter compliance with label instructions to ensure proper herbicide storage and PPE use are important measures to help prevent illness or even death," said NIOSH Medical Officer and senior study author Dr. Geoff Calvert, M.D., MPH.

This article by the National Institute of Occupational Safety and Health (NIOSH), appeared in the online newsletter "Occupational Health and Safety" on February 5, 2016 https://ohsonline.com/articles/2016/02/05/study-shows-scope-of-illness-tied-to-two-common-herbicides.aspx

HOW TO MANAGE HERBICIDE RESISTANCE

If herbicide resistance is confirmed or highly suspected, diverse approaches to managing herbicide resistance need to be incorporated into weed management strategies immediately for the species in question.

1. It is best to stop using the herbicide in question and other herbicides with the same mechanism of action. However, in many cases the herbicide continues to work on a large number of weeds and is still the best choice for overall weed control. If the decision is made to continue using the herbicide, there are several options:

   a. Use proactive weed control (pre-plant or pre-emergence) with an herbicide tank mixture or prepack having at least one mechanism of action that is known to control the resistant weed.

   b. Use post-emergence herbicides only in tank mixtures or prepacks with at least one mechanism of action that is known to control the resistant weed.

   c. Do both a. and b.

   * Any of these options provides at least one additional mode of action (MOA) that will help to prevent further spread of the resistant weed. In addition, other weed control tools should be used to complement the MOA that is still active on the resistant weed so that undue selection pressure is not placed on the additional MOA.

2. If the resistant weed is confined to relatively small areas, take steps to prevent seed production. If the weed is still small enough to control with other herbicides, treat the affected spots. Alternatively, the weed could be removed by hand, or the crop in infested patches could be sacrificed and the weed controlled by destructive tillage or with the use of a non-selective spot herbicide application. Do not let resistant weeds go to seed.

3. Avoid moving seed or vegetative propagules to other fields and farms. Use a power washer or compressed air to help remove seed and plant parts from any equipment used in the field. If any fields have a history of herbicide resistant weeds, use farm equipment in those fields last.

4. Seek advice from the Cooperative Extension Service, your agricultural retailer, crop advisor, and/or University Extension weed specialist to assist in the long term planning of weed control in subsequent crops.

Adhering to the resistance management principles outlined above will help delay or prevent resistance from recurring and prove beneficial in managing resistance the long term.

This article is available at http://pesticidestewardship.org/resistance/Herbicide/Pages/How-to-Manage-Herbicide-Resistance.aspx Accessed on 3 December 2015

SPRAYING BY THE NUMBERS

Herbicides are grouped according to family (e.g., triazines) and target site of action or mechanism of action (e.g., acetolactate synthase, or ALS, inhibitors). Herbicides within a family have similar chemical structures and typically the same site or mechanism of action (MOA). Knowing the chemical family and MOA group to which an herbicide belongs and knowing which other herbicides have the same MOA are critical for creating a plan to prevent or delay development of herbicide resistance

To help ensure standardization, the EPA has requested that manufacturers include a pesticide's MOA group number in a standard format on the label. Outside of the U.S., letters are used in place of group numbers (see Herbicide Resistance Action Committee website below). Herbicides with the same mechanisms of action are assigned the same group number. When a premix label displays the group number(s), the user can easily determine the mechanisms of action included in the premix.

If a label does not contain a MOA group number, you should find it in the table from the North Carolina Agricultural Chemicals Manual by referencing the herbicide brand or common name.

In addition to considering MOA group numbers in the selection of herbicides, review all resistance management recommendations printed on the herbicide label. This may include information on the best management practices for a particular product, target species of most concern and the maximum number of consecutive applications that should be made before rotating to products containing herbicides with different group numbers.

Weed scientists from various herbicide manufacturers have formed the Herbicide Resistance Action Committee (HRAC) to develop uniform resistance management guidelines that can be implemented across geographic regions and across groups of products. Visit HRAC's website at http://hracglobal.com/

This article is available at http://pesticidestewardship.org/resistance/Herbicide/Pages/Spraying-by-the-Numbers--Herbicide.aspx Accessed on 3 December 2015.

USE OF ECONOMIC THRESHOLDS IN INTEGRATED PEST MANAGEMENT: A DIFFERENCE OF OPINION

Economic threshold: the purpose

The economic threshold and the economic injury level are concepts that play an important role in modern Integrated Pest Management (IPM) programs. These concepts were originally designed to manage insect damage in agriculture (Stern et al. 1959), but have been applied since to all pests in landscapes, natural areas, on golf courses, and in structures, including schools, homes, and office buildings. In agriculture, the economic threshold (ET) is the number of pests or level of disease that trigger use of a control measure, usually a pesticide, to keep damage below the economic injury level (Fig. 1). The economic injury level (EIL) is the number of pests or level of disease that will cause a yield loss equal to the cost of the control measure. Since the ET indicates the time to take specific action, it is sometimes called the action threshold.

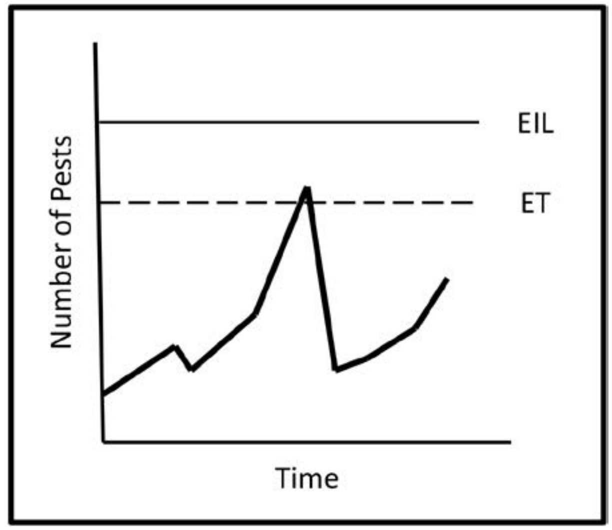


Fig. 1. The number of pests increases over time until the economic threshold (ET) is reached and a control is applied.

Like the EIL, the ET for a crop is usually based on the average number of insect pests on a leaf or plant, the number of spots on a leaf (Fig. 2) or percentage of plant damage, or some other similar measure. It is not as simple, however, as including the cost of the time, material and equipment needed to control the pest, or the value of the crop. The ET will vary based on how susceptible the crop is to the pest, the aggressiveness of the pest or how fast it can reproduce, if weather conditions favor the crop or the pest, days to harvest, value of the crop, and many other factors. Therefore the ET changes with field conditions, weather, value of the crop at harvest, new research, and experience in the field.

Fig. 2. The ET of two spots per leaf has been met, signaling the application of a pesticide. Photo Tom Creswell, Purdue, Bugwood.org

There is usually a delay between the time a control measure, such as the use of a pesticide, is applied and its effect on the pest. Therefore the ET is set low enough that damage caused by the pest does not reach the EIL In spite of these difficulties, economic thresholds are common in agriculture, especially in large-scale farming operations.

A typical case study

The soybean aphid (*Aphis glycines*) caused substantial damage to soybean (*Glycine max*) crops in the early 2000s. In response, a study was conducted from 2003 to 2005 in the northern U.S. to establish an ET for aphids on soybeans (Ragsdale et al. 2007). Previous studies under ideal laboratory conditions found that soybean aphids could double their population in 1.5 days. Using this number to calculate an EIL and ET, the researchers set the ET at three aphids per plant. Field conditions in the northern U.S., however, are much different than those in most laboratories. Therefore, the objective of this study was to calculate an ET based on the average numbers of aphids on randomly selected plants in 19 fields in 6 states. Measurements were made when aphid populations were highest, during the period of bean pod formation and growth. The EIL was calculated using the cost of the insecticide, its application, and expected yield and market value of the crop. The results showed that aphid populations in the field doubled on an average of every 7 days, not every 1.5 days. The average ET based on all control costs, market prices, and yield was 273 ± 38 aphids per plant (range 111 to 567). This ET gave a 7-day margin before the aphid population reached the average EIL of 674 ± 95 aphids per plant (range 275 to 1,399). The earlier estimated ET of three aphids per plant would suggest growers apply pesticide even if the aphid population was growing too slow to reach the EIL. This would cost the growers money by increasing the number of pesticide applications per crop cycle and kill many of the aphid's important natural enemies. The repeated spraying (Fig. 3) triggered by the previously low ET would also increase exposure of the aphid population to an artificial selection for pesticide resistance.

Fig. 3. Mechanization increased the yield and complexity of modern agriculture and also the need for a flexible action threshold. Photo Howard F. Schwartc, Colorado State Univ., Bugwood.org

A modern case study

Economic thresholds can be quite complex. A three-year study in New Zealand used an adjustable action threshold (AT) to manage cotton bollworm (*Helicoverpa armigera*) on tomatoes (Walker et al. 2010). This insect pest attacks a wide range of crops and was causing severe losses on tomatoes due to larvae feeding on the developing fruits. The typical AT in fields monitored weekly was one larva per plant, but this number varied from 1 to 8.3 larvae per plant during the study. The initial AT was based on knowledge that parasitoids killed about 50% of the bollworm larvae. Parasitoids, such as certain species of wasps, lay their eggs in or on a host insect and the hatched larvae of the parasitoids use the host as food. The researchers collected and reared bollworm larvae from the tomatoes until the parasitoids emerged as adults and found that parasitism averaged 71%, not 50%. This higher level of parasitism allowed them to raise the AT and let bollworm larvae increase in number before insecticide was applied. The researchers estimated that this adjustment in the IPM approach helped the growers achieve a 95% reduction in insecticide use.

Economic threshold: a controversy in structural IPM

A recent article by Al Greene, IPM Coordinator for the U.S. General Services Administration, takes issue with the concept of an action threshold (AT). In his May 2015 article, "[A Look Back] The Rise and The Fall of the Action Threshold Concept," Mr. Greene states that the AT is idealistic, far more theatrics than science, and that it "serves mainly to sabotage the credibility of the IPM paradigm."

Mr. Greene discusses three historical elements of the economic threshold (ET) as it applied to agriculture: (1) it was mainly devised as a "business plan" for agriculturalists; (2) the element(s) of the pest control procedure were expensive, mechanized (e.g., large boom sprayers), and done on an inefficient, scheduled basis; and (3) it usually referred to the use of broad-spectrum pesticides. Use of the ET increased profits and reduced the amount of environmentally damaging chemical applied.

The use of the ET moved to ornamental plantings in the urban setting in the 1970s. The goal changed from economic injury to an aesthetic injury, or what the public considered "unsightly." One of the most important aspects of this use of the AT was that time-consuming scouting and data management could be replaced by a simple survey of public opinion.

Now that IPM was in the city, the apparent values of IPM and the AT in reducing costs and directly protecting the human environment led to applying the economic/aesthetic injury level to structural pest control. At this point the article begins to make strong arguments against the feasibility of routine monitoring and establishment of an AT for offices, schools, apartments, hotels, etc. It asks how a pest control business can comply with an AT based on a set number of cockroaches, ants, termites, spiders, or other pests. To date, there is apparently little or no research-based information on which to develop an AT for pests in a structure, especially when humans are present. The author further contends that monitoring pest populations is cost-prohibitive, especially for a pest control business.

Fig. 4. Some argue that an action threshold is not useful in commercial structural pest control. Too often the tolerance of the customer is zero because of "fear and loathing" of these pests. Photo Clemson Univ., USDA Cooperative Extension Service Series, Bugwood.org

Mr. Greene points out that applying the AT to structures was not triggered by economics or aesthetics. It was more due to the advent of modern-day pest control practices and to the "fear and loathing" of some pests by humans. Would customers pay for a service that told them to get used to seeing one to three cockroaches per day in their drawers and cupboards (Fig. 4)? But activist groups at the turn of the century were willing to pursue IPM to reduce pesticide use, especially in schools.

The author ends his article with five reasons to eliminate action thresholds from structural pest control:

- They're arbitrary and inflexible (at any given moment). There are numerous variables in structures that place the arbitrary establishment of an AT against the philosophy of IPM.

- They are ignored by customers. ATs are the "Prohibition" of structural IPM. Customers secretly apply pesticides in the absence of the pest control technician, who must justify the presence of pests they are supposedly paid to control.
- They emphasize superficial data collection rather than synthetic problem solving. IPM programs should employ skill-based decision makers, not people that just treat according to an arbitrary number. Therefore, if the AT fails, companies are blamed for poor hiring practices.
- They're already set at one or very close to one for most pests in most programs that use them. Preventative treatments, applying pesticides in the absence of pests, are not allowed in most IPM programs, so is an AT of one much different?
- They're now superfluous for decreasing pesticide use and risk. Routine spraying of pesticides indoors is no longer acceptable. Currently, the risk of pest infestations is reduced by baits, trapping, sanitation, etc., so the AT is no longer needed.

Summary

Economic thresholds in agriculture are based on knowledge of the pest, crop, and environment during each crop cycle or season. They provide an informed response to the question, "When should I spray"? An adaptable economic threshold can save money by delaying expensive control measures, allowing for the effects of beneficial organisms to be achieved, reducing potential harm to humans and the environment, and slowing the evolution of pesticide-resistant organisms. Structural pest control incorporates human responses, such as a "fear and loathing" of pests, that are not usually present in outdoor pest control. These responses among others can affect the number of pests a homeowner, office worker, student, or school administration is willing to accept. According to Mr. Greene, an action threshold is no longer necessary in a structural pest management program that includes samitation, eliminating places pests can enter the structure, and baiting and trapping.

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ILLUSTRATED GLOSSARY

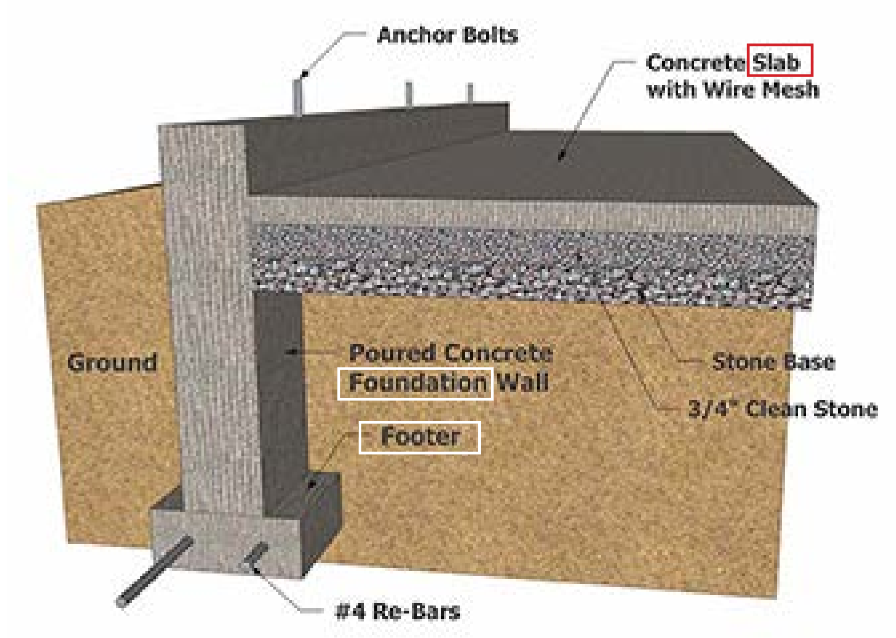
Terms from Pesticide Labels

(recertification)

Foundation. The entire masonry substructure below the first floor or frame of a building, including the footing upon which the building rests.

Footing (footer). That portion of the foundation of a structure that spreads and transmits the load directly to the soil.

Slab. A structural part of most modern buildings. Horizontal slabs of steel-reinforded concrete 4 to 20 inches thick are usually for floors and ceilings with thinner slabs for driveways, etc.

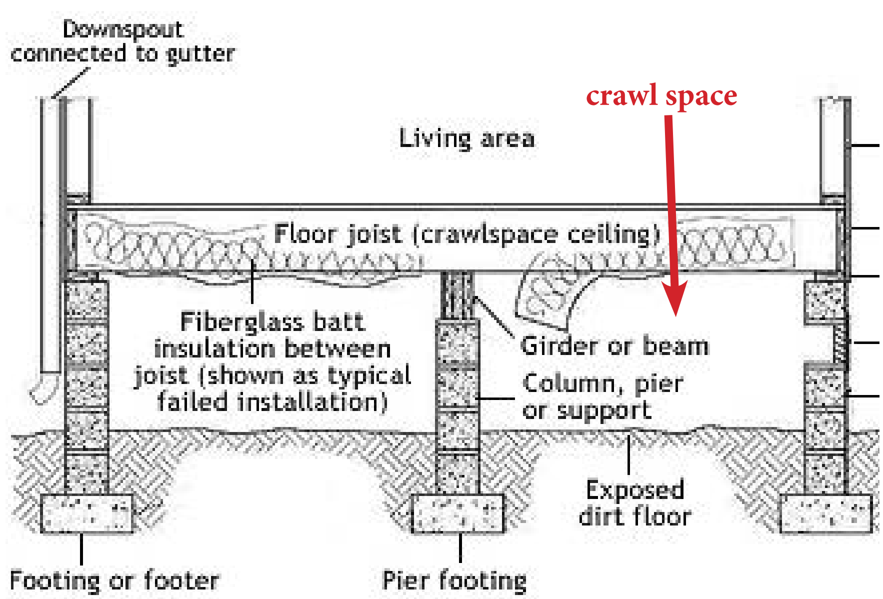


Courtesy denverconcretecompany.net

Label example. *Care should be taken that the treatment solution . . . which may be located on the exterior of the* <u>foundation</u> *in close proximity to the* <u>footing</u> *of the structure. Soil should be treated around sewer lines, plumbing, . . . extending from the soil through a* <u>slab</u>.

Crawl space. A shallow unfinished space beneath the first floor or under the roof of a building especially for access to plumbing or wiring.

Label example. *For* <u>crawl spaces</u> *apply at the rate of 4 gal of emulsion/10 lin ft/ ft of depth from grade to the top of the footing.*



From apexwaterproofing.net

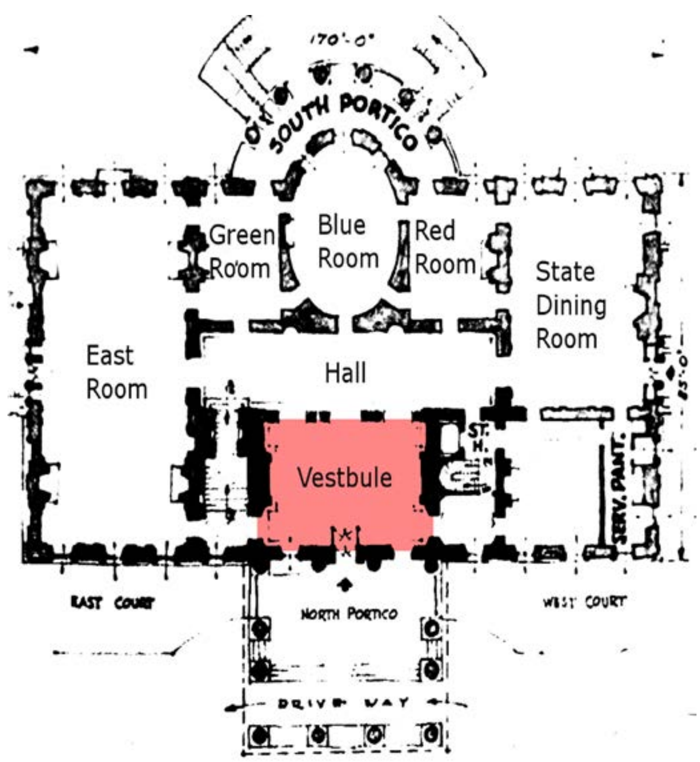
Stoop. A small set of steps leading up to a flat area in front of an entry way. Often used in cities as a place to congregate and talk.

Label example. *Applications may be made . . . under slabs,* stoops*, or porches; . . .*

Photo by Lewis Hine. Newsboys on a stoop. Wilmington Delaware_1910. United States Library of Congress

Vestibule. An antechamber, hall, or lobby next to the outer door of a building (syn. entrance hall, foyer, anteroom, waiting room, etc.)

Label example. *Examples of nonfood areas include garbage rooms, lavatories, entries and* vestibules *. . . .*



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

PREVIOUS RECERTIFICATION ARTICLES

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

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