Education, Communication, and Outreach Initiatives

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NC State University
A&T State University
COOPERATIVE EXTENSION
Empowering People · Providing Solutions

Presentation Outline

- Pesticide Safety Education Program
- Pesticide Environmental Stewardship Website
- NAPPC Initiative

Two Classes of Pesticides

- Restricted-use: Pesticide that could harm humans and/or environment, requiring use by certified applicator

- Unclassified or General-use: Pesticide that does not have the characteristics of a restricted-use pesticide

Mission:

To promote the responsible use of pesticides through educational resources and training

- Private applicators: 16,500 (~1/3 of NC farmers)
  - ✓ Use an RUP on land that they own or rent in order to produce an agricultural commodity
- Commercial applicators, dealers and consultants: 17,000
  - ✓ Use or supervise the use of pesticides as part of their job or professional service.

The Pesticide Environmental Stewardship (PES) Website is:

A One-stop Shop
for up-to-date information
on proper pesticide use.

Target Audience…

Anyone (trained or untrained)
who handles pesticides,
provides advice or training concerning their use,
or who has concerns
about pesticides in the environment

PES Website Goals:

- Summarize principles of pesticide stewardship;
- Direct users to resources (links) by stewardship topic; and,
- Provide educational modules and self-assessment tools.
- Develop on-line programs for recertification of licensed pesticide applicators or to prepare users for state certification exams.

PES Webspinning Team

- Ron Gardner, Cornell Univ.
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- Carrie Foss, WA State Univ.
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Financial Support

Center for Integrated Pest Management

Supporting Organizations

BASF
Bayer Crop Science
Certification and Training Assessment Group (CTAG)
Coalition for Urban/Rural Environmental Stewardship (CURES)
CropLife America
Dow AgroSciences
Entomological Society of America
EPA Pesticide Worker Safety Programs
eXtension
Insecticide Resistance Action Committee (IRAC)
Monsanto
NSF-founded Center for Integrated Pest Management
National Agricultural Aviation Association (NAAA)
North American Pollinator Protection Campaign
Syngenta Crop Protection
The Pesticide Stewardship Alliance (TPSA)
Responsible Industry for a Sound Environment (RISE)
Weed Science Society of America (WSSA)

Major Topics

http://pesticidestewardship.org

- Calibration
- Container Management
- Disposal
- Drift Management
- Integrated Pest Management
- Personal Protective Equipment
- Pollinator Protection
- Recordkeeping
- Resistance
- Soil Fumigation
- Spill Prevention and Cleanup
- Storage
- Surface and Groundwater
- Transportation
- Wildlife Protection
- Worker Protection Standard
- Organic Crop Production (draft)
- Pesticide Safety for the Homeowner
- How to Read the Label

Pesticide Environmental Stewardship

Promoting Proper Pesticide Use and Handling

Supported by CIPM

Center for Integrated Pest Management



Pesticide Environmental Stewardship

The Pesticide Environmental Stewardship (PES) Website is sponsored by the Center for Integrated Pest Management. PES provides convenient access to information on proper pesticide handling. All subject matter content on this site has been reviewed and posted by Pesticide Safety Education Program coordinators from the Cooperative Extension Service. This website is intended for a national audience with links to state-specific information, where available. Crop producers, pesticide dealers, commercial/professional applicators and the general public will benefit from the information presented in each topic, or module. Links to resources available on other web sites or in print are presented in each module. **Pesticide educators are welcome to use or adapt the content that appears directly on the PES website. Images may be subject to copyright.**

Topic titles are listed in the sidebar on the left. "Click" on the topic title to view the introduction. Upon landing on the introductory page, a list of subtopics will appear below the topic title. Additionally, a "PES Table of Contents" page with brief descriptions of each topic can be accessed by clicking on the link below.

PES Table Of Contents

Resources to download and print - brochures, documents etc.

Acknowledgments : **the creators and contributors to this website**

eXtension Latest : pesticidestewardship

What is a pesticide?

What can be done to prevent a pesticide spill?

How can I determine if a pesticide kept in storage for a long time is still effective?

If air-induction nozzles reduce drift why can't I use if for every application?

More...

Create your own eXtension widget

Pollinator Protection

Compiled by Wayne Buhler

Introduction

Pesticides play an important role in controlling insects, weeds, and diseases on farms and in urban landscapes. The areas treated for pests are often shared by pollinators; mainly insects such as bees, butterflies, wasps and flies, and also birds and bats. Pollinators visit flowers in their search for nectar and pollen. During a flower visit a pollinator may accidentally brush against the flowers reproductive parts, depositing pollen from a different flower. The plant then uses the pollen to produce a fruit or seed.

Pollinators are essential to the survival of the majority of flowering plants in our environment and to the production of over 90 different crops. Over $15 billion annually is attributed to the value of pollination of food crops, especially fruits, vegetables, and nuts. It is estimated that pollinators are responsible for 1 out of every 3 bites of food that we eat.

Insects are the most common and abundant pollinators. Among the pollinating insects, the honey bee is relied on to perform most of the commercial pollination. As a pesticide applicator, you are critical to reducing pesticide risks to honey bees. Proper pesticide use starts with following the product label. Also, the use of Integrated Pest Management (IPM) and Best Management Practices (BMPs) wherever pollinators are present will prevent harming honey bees, their food sources, water and habitat.

Although the information in this module is targeted to the protection of honey bees, the stewardship principles and practices described are applicable to all pollinators.

Sources:

1. Protecting Pollinators: Why and How Pesticide Applicators Can Help Them. North American Pollinator Protection Campaign.
2. How to Reduce Bee Poisoning from Pesticides. H. Riedl, E. Johansen, L. Brewer, and J. Barbour.
3. Protecting Honey Bees from Pesticides. by Malcolm Sanford, Extension Beekeeping Specialist, Univ. of FL.
4. Bee Health: The Role of Pesticides. Congressional Research Service 7-5700.
5. Pollinators and Pesticide Stewardship. Coalition for Urban/Rural Environmental Stewardship, Syngenta, and Bayer CropScience.

Honey Bees and Beekeeping

Honey bees live and function together as an intricate insect society. Each colony consists of 3 kinds (or castes) of individuals. At the heart of the honey bee colony is the queen, which can lay up to 2,000 eggs per day and lives for 2-4 years. Colony duties are carried out by sterile female worker bees, which live for an average of four weeks during the summer and much longer during the winter. Several hundred male drones live during the summer months and serve only for reproductive purposes.

The number of bees in a colony varies by the season and availability of nectar and pollen-bearing blooms. Their numbers may drop from a peak of up to 60,000 bees in midsummer, to only 8,000 or less after a long winter. The vast majority (98-99%) of the bees in a colony are the workers that carry out specialized tasks based on their age:

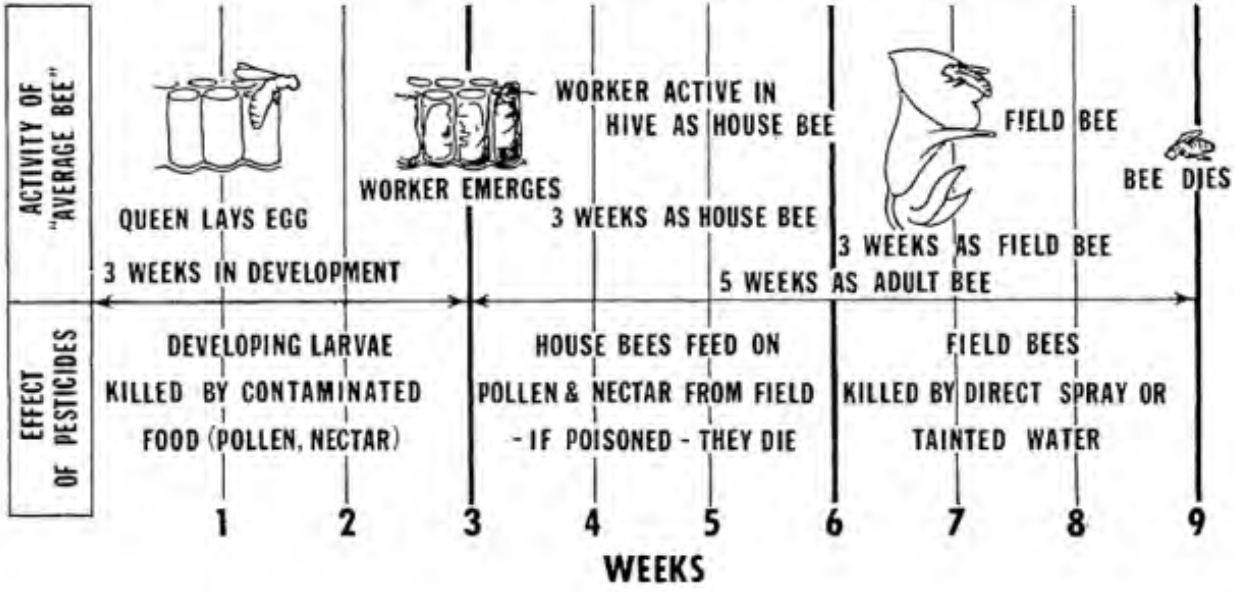

Photo: NCSU Entomology

House bees: These bees are the youngest worker adults up to 21 days old. They care for the brood (eggs, larvae, and pupae), process the food, and clean the nest. House bees can be poisoned by contaminated pollen which is collected and brought to the hive by field bees, then stored in the hive.

Field bees: These bees are workers 21 days old and up. They are capable of amazing feats, such as communicating exact locations of nectar sources to their nest mates by orienting to polarized light and the sun, ventilating and air conditioning their home, and defending their family with their very lives. Field bees can be killed by contact with pesticides outside the hive, but most times they collect contaminated nectar and pollen and contribute to poisoning their nest mates. If field bees are killed, then young bees are forced into the field earlier than normal further stressing the colony.

Worker bees can forage 2-3 miles from their hives and may visit multiple plant species in both crop and non-crop areas for nectar and pollen throughout the growing season. The time and intensity of pollinator visitation to a crop or vegetated area depends on the abundance and attractiveness of the bloom. The flowers on some crop plants may be open to honey bees all day while others are only attractive in the morning or early afternoon. Once a nectar source is found, bees prefer to work that particular plant or crop to exhaustion before changing to another plant (see Malcolm Sanford note below**). The daily activity of bees also is important to keep in mind for timing certain pesticide applications: unless it is raining or below 55 degrees F, bees forage sun up to sun down.

The danger of pesticides to worker honeybees during their lifetime (M. Sanford)



Commercial beekeepers, on average, have more than 300 hives, and transport ("migrate") their colonies during the year to provide pollination services to farmers. Hives may be moved over 1,000's of miles annually. The USDA estimates that 2.9 million bee colonies were rented for pollination by US farmers in 2007. An estimated 1.5 million colonies are needed each year to pollinate California's almond trees alone. Managed honey bee colonies are placed in or near crops that require pollination. The beekeeper and the farmer develop a contract (See Cooperate and Communicate) and have a mutual interest that the bees are not harmed by the application of pesticides to those crops. When pesticides are needed, several techniques are used to adequately protect the pollinators and control pests of these crops (see Read and Follow the Label and Pesticide Applicator BMP's).

Typically, colonies are placed in or near these fields for a short time period; ranging from one to eight weeks depending upon the crop pollination requirements. During the remainder of the year, most managed honey bee colonies reside within flight distance of crops which are attractive to bees but do not require pollination by insects such as cotton, corn, soybeans, and many other major crops. Honey bees will visit these crops or areas whenever nectar or pollen is available. It is critical for growers to be aware of the activity of pollinators in these crops and follow the practices outlined in this module to avoid harming them.

Bees in Peril

Beekeepers and producers of fruit, nut and vegetable crops are concerned that the availability of honey bees is not keeping pace with the growing demand for pollination services. In the U.S., a phenomenon called 'Colony Collapse Disorder'--first discovered in 2006--has caused mysterious and catastrophic losses. Scientists across the country have been looking for the cause or causes of Colony Collapse Disorder, and the decline of bees in general, within four broad categories:

- Pathogens (such as fungi, amoeba, bacteria, and viruses that infect honey bee brood and adults)
- Parasites (such as tracheal (internal) and Varroa (external) mites—Varroa mites injure adult bees and brood by direct feeding and transmission of pathogenic viruses)
- Environmental Stressors (such as miticides and antibiotics used inside the hive and pesticides used outside the hive; or malnutrition through lack of nectar diversity); and also
- Management Stressors (such as transportation stress by migratory beekeepers, overcrowding, feeding practices, and genetic fitness of the queen source).

What exactly is causing the increased colony losses remains unknown. It seems that rather than one factor there is a mixture, or accumulation, of potentially synergistic causes. A better understanding of how the suspected causes interact and how bees respond to those causes is needed. For more information on Colony Collapse Disorder see Resources and Suggested Reading.

Pesticide Toxicity to Honey Bees

As a general rule, insecticides are more toxic to honey bees than fungicides and herbicides, but most insecticides can be applied to crops with little or no hazard to bees. However, because honey bees are insects, they are highly sensitive to several types of insecticides.

Most poisonings occur when these bee-toxic insecticides are applied to crops during the blooming period. Poisoning of pollinators can also result from:

- DRIFT of pesticides onto adjoining crops or plants that are in bloom,
- CONTAMINATION OF FLOWERING GROUND COVER plants when sprayed with pesticides,
- Pesticide RESIDUES, PARTICLES, OR DUSTS being picked up by foraging pollinators and taken back to the colony, and/or,
- Pollinators drinking or touching CONTAMINATED WATER sources or dew on recently treated plants.

The U.S. Environmental Protection Agency (EPA) evaluates a pesticide for toxicity to pollinators if it is used outdoors. A pesticide's toxicity to bees is measured by:

1. The pesticide dose that causes death of bees; and
2. How long the pesticide can affect bees after it has been applied to plants.

EPA assesses a pesticide's toxicity using three types of studies:

1. Honey Bee Acute Contact LD_{50}—a lab study determines the amount of pesticide that kills 50% of a test group of bees (LD=Lethal Dose)

2. Honey Bee-Toxicity of Residues on Foliage-a lab test that determines the amount of time that pesticide residues on leaves remain toxic to honey bees.

3. Field Testing for Pollinators may be required if the above tests indicate adverse effects on bees.

If the Acute Contact LD_{50} is less than or equal to 2 micrograms per bee, the pesticide is classified as
Toxicity Category I, "highly toxic to bees."
If the LD_{50} is less than 11 but greater than 2 micrograms per bee, it is classified as
Toxicity Category II, "toxic to bees."
If the LD_{50} of the pesticide is greater than 11 micrograms per bee (Toxicity Group III), it is relatively nontoxic, and no bee caution statement is required on the label.

Toxicity Categories I and II are "bee-toxic pesticides" and the label will have specific use instructions to reduce the risk to pollinators (see Read and Follow the Label).

FURTHERMORE, some bee-toxic pesticides have Extended Residual Toxicity (ERT/RT), or longer term effects, that require somewhat different protective measures. When a bee-toxic pesticide has residual toxicity, it can not only harm pollinators when the application contacts them directly, but also residues on the plants can harm pollinators that visit the treated area later ("visiting").

The residue is the amount of pesticide that remains on the plants after they have been sprayed. The residue decreases over time as the pesticide degrades and the rate of decrease depends on the pesticide and environmental conditions. Some pesticides are very toxic to bees but will rapidly decay to less toxic compounds. Other compounds have longer residual toxicity.

If a bee-toxic pesticide does not have extended residual toxicity, it can harm pollinators exposed to direct treatment only ("actively visiting"). A bee-toxic pesticide that does not have extended residual toxicity can often be applied after pollinator foraging is complete (such as in the early evening) without harming pollinators that arrive the following day (see Pesticide Applicator BMPs). A bee-toxic pesticide with extended residual toxicity can require additional application restrictions as indicated on the label.
Remember that most bee poisoning incidents occur when insecticides that are highly toxic to bees and that have a residual hazard longer than 8 hours are applied to bee-pollinated crops during the bloom period.

Certain pesticides (for example, some systemic pesticides) are now being evaluated for their potential to have delayed, sub-lethal (injurious), and/or brood effects on bees and other insect pollinators. Research is also being conducted to determine if certain application methods, pesticide formulations, or carriers can increase the chance of pollinator exposure. The pesticide manufacturer can provide up-to-date product-specific information on stewardship measures that can help protect pollinators.

Read and Follow the Label

The label will indicate if a pesticide is toxic to bees when the application contacts them directly or by residues. Before using the pesticide, look under the "Environmental Hazards" and "Directions for Use" headings for any precautions that need to be taken. See the following example.

ENVIRONMENTAL HAZARDS:
This pesticide is highly toxic to bees exposed to direct treatment. Do not apply it or allow it to drift to crops or weeds on which bees are actively foraging

Don't assume that all bee cautionary statements are the same. The subtle differences regarding treating plants while bees are VISITING, or treating plants while bees are ACTIVELY VISITING, are important to assure adequate protection for pollinators. Some labels warn against the use of the product on blooming crops by stating "Do not apply to blooming crops or weeds if bees are VISITING in the treatment area." "Visiting the treatment area" refers to bees that may visit the plants after treatment (the bees may or may not be working the crop at the time when the pesticide application is planned) and pertains to products that do show Residual Toxicity**; such products require a higher level of care in avoiding pollinator exposure by not applying them while the crop is in bloom. Realize that the application "window" (period when the timing is right) may be reduced due to factors such as extended crop bloom or unfavorable weather conditions (see Pesticide Applicator BMPs). "Actively visiting the treatment area" refers to bees you see on plants and pertains to products that do not show Residual Toxicity.

**Residual Toxicity Defined (from California Department of Pesticide Regulation)

Residual Toxicity (RT) time is that period of time after completing a pesticide application until there is minimal toxic effect to bees. The RT time is specified on product labeling and is based upon Residual Toxicity$_{25}$ (RT_{25}) studies. The RT_{25} studies determine 25% bee mortality based on the test bee populations exposed to the formulated pesticide product applied to foliage (from CDPR) It is believed that 25% of the colony can be lost and the colony can regenerate. Pesticides with RT_{25} values lower than 8 hours present a minimal hazard if they are applied during late evening or night. Pesticides with RT_{25} values greater than 8 hours cannot be safely used when they might contaminate bee forage.

Residual Toxicity (RT_{25}) is very useful information, but it is not available for all pesticides. Systemic pesticides are not considered in RT_{25} assessments; it is based solely on surface contact and exposure.

Pesticide Applicator BMPs

Proper pesticide use avoids harm to honey bees, their food sources, water and habitat. Best Management Practices (BMPs) are not considered regulatory requirements (such as label directions and local ordinances), but they can be shown to provide direct benefits to pesticide users, growers, and all of us who enjoy the products of pollination. The following BMPs apply to virtually all pest management decisions and actions. Realize that there may be other BMPs, not listed below, that are specific to certain crops and locations.

Apply pesticides only when needed...

Use an **Integrated Pest Management (IPM)** Approach:

- Monitor and assess pest populations to determine if levels warrant control.
- Select the best combination of pest control options that minimizes risks to pollinators.
- For more information on IPM click here.

When a Pesticide is needed...

Be Alert to Bloom

The presence of bloom is the key factor in pollinator exposure to pesticides. Honey bees and other pollinators are most at risk of poisoning when bee-toxic pesticides are applied to CROPS, WEEDS* or OTHER VEGETATION that is blooming.

Avoid bee-toxic pesticide use during bloom.

-OR-

Apply bee-toxic pesticides to blooming crops only after bees are done foraging for the day and preferably at night (but with a predicted residual toxicity time interval that is likely to protect bees the following day, based upon forecasted weather conditions—read more on residual toxicity and weather below).

*When possible, remove blossoms of weeds such as dandelion in orchard cover crops before applying bee-toxic pesticides.

Employ Residual Toxicity Safeguards

Many bee-toxic pesticides can be used on blooming crops in an appropriate "window" of time. Evening applications are generally the least harmful to honey bees, but stricter application restrictions may be necessary when a pesticide has extended residual toxicity (ERT). Pesticides that have an ERT to bees of more than 8 hours are hazardous when that toxicity will extend into the period of bloom. Pesticides that do not have ERT, or an ERT of 8 hours or less, have a more flexible application "window"...

Pesticides with an ERT of 4 to 8 hours should be applied between late evening--after bees have stopped foraging—and midnight. However, pesticides with an ERT of less than 4 hours can be applied between late evening and early morning. Remember that honey bees forage sun-up to sun-down, so the timing of an early morning application will need to correspond to bee activity (for example, two hours before sunrise for pesticides with an ERT of two hours).

Check the Weather

Environmental conditions affect pesticide persistence. Daytime applications at low temperatures may cause some classes of pesticides to remain toxic much longer than during warm weather. Cloud cover also may prolong toxicity due to lower levels of ultraviolet light which breaks down many pesticides. Do not apply bee-toxic pesticides with extended residual toxicity on nights when dew is forecast. Dew may re-wet pesticides and increase bee exposure.

Environmental conditions also affect bee activity. When high daytime temperatures encourage bees to begin foraging earlier or continue later than usual, adjust application times of bee-toxic pesticides accordingly. Experience shows that when bee-toxic pesticides are applied before or during cold nights, followed by warm summer days, the incidence of bee kills greatly increases.

Use the Least Hazardous Formulation

- Dust and microencapsulated formulations are most hazardous to bees because they are similar in size to pollen and tend to stick to bee hairs.
- Granular formulations are the least hazardous when bees are present.
- Emulsifiable concentrates formulations usually are less hazardous to bees than wettable powders because the powders remain toxic in the field longer.

Minimize Drift

Honey bees will visit the blooms of crops and/or weeds near target crops and be unintentionally impacted there by drift and pesticide residues. Keep the product on the intended area/crop (see the Drift module) and apply pesticides with equipment that has been calibrated for the particular application (See the Calibration module).

Initial compilation courtesy of Jim Wilson, PhD South Dakota State University

Introduction to Pesticide Drift

Pesticide drift occurs whenever pesticide leaves the intended target site **through the air during or soon after application.**

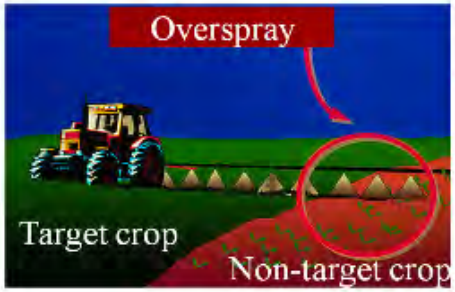
Pesticide drift may cause injury to farm workers and other people, particularly children, adjacent crops or other non-target plants, livestock, sensitive environmental areas, fish and wildlife. Even if visible injury does not occur, illegal residues may be present in adjacent areas. Pesticide drift may also result in regulatory fines, legal liability, and litigation.

When pesticide drift occurs, some part of the pesticide is not reaching its intended target, and the potential benefit from the application is reduced. The likelihood of pesticide drift will be reduced if the applicator understands the relationships among pesticide product, application equipment, and site and weather conditions.

This is drift

So is this

This is not drift



Neither is this

Calibration

Compiled by Wayne Buhler

Applying pesticides correctly involves diluting the product (except 'Ready-to-Use' formulations) to the appropriate concentration and using calibrated application equipment. This module is designed as a guide for the proper dilution and application of pesticides. It includes practical calibration techniques for common pesticide application equipment. Much effort was made to keep the text brief and provide an abundance of examples.

Text and illustrations in this module are derived from a 70-page booklet entitled "Pesticide Applicator's Handbook". For ordering information, send an e-mail message to wayne_buhler@ncsu.edu with the words "Pesticide Applicator Handbook" in the subject line. Dr. Wayne Buhler, Professor, North Carolina State University, served as the Technical Reviewer for the "Pesticide Applicator Handbook" and compiled the information in this website. Appreciation is expressed to Dana Babbs, Greg Miller, Sandy Shultz, Brenda Bunch and Grace Jenkins for help with the graphics presented in this module.

A brief description of, and links to, the various topics within this module follows:

Introduction
Explains the importance of calibration

Doing the Math
How to calculate the correct amount

Nozzle Tip Selection
Steps to select and position nozzles on a boom

Precalibration
Prepare your spayer for calibration

Formula Calibration Method
The '5940' method follows Nozzle Tip Selection

Ounces-to-Gallons method
Describes the 1/128th of an acre method

Backpack Sprayer
Describes a simple method for calibrating a backpack

Spray Gun
Calibration of a useful sprayer for commercial applicators

Rotary Spreader
Steps to measure distribution and output of granules

Drop Spreader
Learn several methods to calibrate this equipment

Band Applicators
Calibration for banded application of granules in row crops

Measurements, Conversions, and Formulas
Common equations and coversions for pesticide application

Doing the Math

Compiled by Wayne Buhler

Proper mixing and application of pesticides can be accomplished by understanding proportions, fractions, and percentages.

Proportions and cross multiplication:

If you understand how to express your rate question as a proportion, you will have the key to most of the rate calculations needed for pesticide applications.

A proportion is a ratio:

"A is to B as C is to D" or

"1 is to 2 as 4 is to 8" or

$$\frac{1}{2} = \frac{4}{8}$$

If you have an unknown value (N) in your ratio, cross multiply the two terms diagonal to each other:

$$\frac{1}{2} \times \frac{N}{8}$$

$(2 \times N) = (1 \times 8)$

$2N = 8$

and then divide by the number with the unknown (N) to get the value of N:

$$N = \frac{8}{2}$$

$N = 4$

When using proportions to determine pesticide application rates, the units on the top and bottom of one ratio have to match the units on top and bottom of the other ratio.

Example:

The label indicates that 2 lbs. of granular insecticide are to be applied per 1,000 sq. ft.

How much do you need to apply to an area that is 5,000 sq. ft.?

Express this as a proportion:

$$\frac{2 \text{ lbs.}}{1{,}000 \text{ sq. ft.}} = \frac{N \text{ lbs}}{5{,}000 \text{ sq. ft.}}$$

Nozzle Tip Selection

Compiled by Wayne Buhler

Nozzle tips must be selected according to the spray coverage, droplet size, and application volume desired.

Follow these steps to select a nozzle for a particular application:

Step 1.

Refer to the pesticide label for the recommended spray volume in gallons per acre (GPA) for your situation. The spray volume is the gallons of carrier (water, fertilizer, etc.) and pesticide applied per acre.

Step 2.

Calculate ground speed by traveling 200 feet in the field and using the equation below: Use the average of three test runs for 'Time'.

$$\text{Speed (MPH)} = \frac{\text{Distance (feet)} \times 60}{\text{Time (seconds)} \times 88}$$

Step 3.

Substitute numbers into the following equation to determine flow rate required from each nozzle in gallons per minute (GPM):

$$\text{GPM (per nozzle)} = \frac{\text{GPA} \times \text{MPH} \times \text{W}}{5{,}940}$$

Where:

GPM = gallons per minute of output required from each nozzle

GPA = gallons per acre desired

MPH = miles per hour travel speed

W = effective spray width per nozzle in inches

For broadcasting:

W = nozzle spacing on the boom

For band spraying:

$$\text{W} = \frac{\text{band width (in.)}}{\text{\# nozzles per band}}$$

Provide Clean Water

Beekeepers and growers should discuss and address the need for clean drinking water for bees, particularly when the weather is warm (See Cooperate and Communicate). This should include multiple stations. Water does not have to be limited to human-made stations (for example, a river, lake or pond, if it provides clean water, would do). Remove puddled water containing bee-toxic pesticide left by chemigation or other treatment methods. Vinegar may be added to these puddles as a bee deterrent.

Communicate with Beekeepers

Cooperation and communication among growers, applicators, beekeepers, crop advisors and local officials greatly increase the likelihood of success in protecting pollinators and their habitats (see Cooperate and Communicate). Take the initiative to establish good relations and communication with commercial and local beekeepers. Click here to read the communication/cooperation success story from Yuma.

Learn about Local Regulations/Programs

Check for specific local ordinances pertaining to pollinators, especially beehive locations or designated preserves (if applicable). In many farming areas, state departments of agriculture can provide information about pollinator protection. Some regions require that commercial beehive operations register the location where hives are being kept. Many states have regulations (for example, the Iowa "Pesticide/Bee Rule") intended to reduce the hazard of insecticide applications to bees.

Minimize off-Site Drift of Seed Treatment Materials

Seed treatments (insecticide and/or fungicide active ingredients) reduce potential risks to workers, minimize potential runoff to waterways, and lower the overall amount of pesticide applied in the environment. To reduce pollinator exposure, follow these precautions (specific label information takes precedence).

- Always use high quality seed free from excessive dust.
- For seed types which require that pesticides be coated onto the seed, always use an appropriate coating system that keeps abrasion of coated pesticide to a minimum.
- Follow planter manufacturer recommendations for use of talc, graphite, or other flow agent. Avoid excess use to minimize dust.
- Avoid releasing dust from seed treatment into the air. When opening seed containers and during filling, emptying, or cleaning of the planting equipment, avoid dust movement that could cause exposure.
- Avoid off-site movement of dust form treated seeds during planting. Be aware of wind speed and direction.
- To protect birds and mammals, treated seeds must be incorporated into the soil at proper planting depth, in particular at row ends and field corners.
- Be aware of the presence of flowering crops in or adjacent to the field which could attract pollinators.
- Ensure that no blooming weeds are present in the field at planting, through use of herbicides or tillage.

Beekeeper BMPs

With a barrage of perennial pests in the hive and a multitude of environmental stressors outside, beekeeping has come to require more intensive management to maintain healthy, strong colonies (click here for more information on managing honey bee health).

Manage Varroa Mites

Among in-hive pests, the Varroa mite is the major threat to honey bee health and survival. This mite weakens the entire bee colony as an external parasite of adults and brood, and as a vector (transmitter) of deadly viruses. Mite management relies on a limited number of cultural practices and a similarly limited number of chemical treatments (Varroacides) to which resistance is common. The most effective way to reduce/avoid Varroa resistance to existing and new products is to rotate, or alternate, the use of two of more EPA registered Varroacides. For more information on understanding resistance and resistance management click here. New mite treatment options are being investigated by various institutions and companies. To find a product that's virulent to mites but harmless to the bee is an enormous challenge. It is critical, therefore, that current Varroacides be used judiciously.

Follow Good Apiary Practices

In addition to making the best use of currently available mite management solutions, the most efficient way of managing bee health is through good apiary practices. These include hygienic measures, a sound knowledge of pathogen and bee life cycles, and providing good nutrition throughout the year. Honey bees have a limited capacity to metabolize chemical toxins, and some toxins can accumulate in beeswax combs. Therefore, it is a good idea to renew combs by replacing a few of them from each hive annually.

Inspect your apiaries regularly so that any problem from pesticide damage can be detected. Dead bees can be swept away or eaten by scavengers quickly. If you have a pesticide poisoning incident report it (see Recognizing and Reporting Bee Kills). Click here for any example from Washington State Department of Agriculture. Without this report, the regulatory agencies have no information to indicate that anything is of concern about current pesticides or the manner in which they are being used or misused.

Follow Local Regulations/Programs

Check for specific local ordinances pertaining to pollinators, especially beehive locations or designated preserves (if applicable). In many farming areas, state departments of agriculture can provide information about pollinator protection. Some regions require that commercial beehive operations register the location where hives are being kept. There may be restrictions concerning establishment of apiaries, as well. Many states have regulations (for example, the Iowa "Pesticide/Bee Rule") intended to reduce the hazard of insecticide applications to bees.

Cooperate and Communicate with Others

Communication among growers/pesticide applicators, crop advisors, and beekeepers is essential for pollinator health and safety. Everyone benefits from clear communication and willing cooperation. Click here for an example from Yuma.

Grower and Commercial Beekeeper Cooperation

When a grower rents colonies for crop pollination, he or she should work with the beekeeper to:

- Develop a written agreement, or contract (see samples below), outlining the period for using the hives and important considerations including details of the beekeeper's responsibility to provide strong colonies and the grower's responsibility to safeguard the bees from poisoning. The beekeeper should consent to a grower's request to see how strong the hives are by opening some hives that the grower selects.
- Review the cropping system and pest management practices in the area before the beehives are delivered.
- Clearly define responsibilities for providing clean water and food sources.
- Place hives away from areas that may be exposed to bee-toxic pesticides during the pollination period. Inform neighboring growers and custom applicators operating in the area where hives are located so precautions can be taken when treating nearby fields.

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- Where possible, remove hives if bee-toxic pesticides will be applied in the immediate vicinity. If applications of these products near beehives are unavoidable, shield beehives** with wet burlap to confine and protect the bees, but ensure that bees are kept cool at all times.

  *** Moving or covering bees is not a sustainable practice for commercial beekeepers—even if informed in advance—and should not be considered a viable solution for pollinator safety. Moving a colony of bees is much different than moving livestock from one pasture to the next. Bees "remember" where they were yesterday and where the bloom is in relation to the hive. Because they can forage up to 3 miles away, they must be moved a significant distance and moving them in the middle of a honey flow (period of time when nectar is readily available in blooming flowers) disrupts the continuity of life within the hive. As a result the honey crop is lost and the hive is stressed.***

- Post the beekeeper's name and contact information near the hives. This information should be large enough to read at a distance.

Sample Grower/Beekeeper Contracts: Univ. of GA, Univ. of FL

Grower and Aerial Applicator Cooperation

Growers and the aerial applicators they hire, must cooperate when aerial applications are made in areas where beehives are located. Specifically, growers and applicators should work together to:

- Accurately identify the proper site for application. Use GPS coordinates, if the applicator has this capability. Review a sketch of the field and surrounding areas.
- Accurately identify and confirm the location of beehives near the treatment site or in neighboring fields.
- Ensure that weather conditions are appropriate for aerial applications by reviewing the forecast prior to initiating treatments.
- Never make applications when conditions are marginal. Doing so can be illegal and can jeopardize the applicator's licenses as well as the industry standard for stewardship.
- Make sure aerial applications are done properly, avoiding direct overspray of beehives or off-site movement toward beehives and other sensitive sites.
- Mount the spray boom on the aircraft so as to minimize drift caused by wing tip vortices. The minimum practical boom length should be used and must not exceed 75% of the wing span or rotor diameter.
- Release spray at the lowest possible height consistent with pest control, and flight safety. Applications more than 10 feet above the crop canopy should be avoided.

Recognizing and Reporting Bee Kills

Common symptoms of bee poisoning are:

- Excessive numbers of dead bees in front of hives.
- Lack of the usual numbers of foraging bees (if not weather-related).
- Bees in front of hives that appear disoriented and are unable to fly.

Photo: hive-mind.com

Healthy hives may experience daily die-off up to approximately 100 dead bees per day per hive. Higher numbers may be a sign of a bee poisoning or exposure to another stress (e.g., poor hive conditions, inadequate food supply, parasites, disease, etc.).

These symptoms cannot be taken as definite signs of pesticide poisoning. Many chronic management problems such as starvation, winterkill, chilled brood, or disease may result in the same symptoms. Often pesticides may cause these problems in an indirect manner. So it is difficult in many instances to categorically state that bees have been poisoned.

For more information on bee death, including colony collapse and how to report a bee death incident, visit the EPA's Pollinator Protection website. Also, see Resources and Suggested Reading.

The EPA incident report can be found at http://pi.ace.orst.edu/erep/, or submit an email to beekill@epa.gov. Some states have incident reporting forms (Washington State example). Contact your state Department of Agriculture or Department of Pesticide Regulation for help. Additionally, Bayer CropScience provides a "Bee Health" hotline at 1-800-334-7577.

Resources and Suggested Reading

The North American Pollinator Protection Campaign (NAPPC)
Several pages containing educational material and resources that promote the health of pollinators, critical to food and ecosystems, through conservation, education, and research, Including:

- Protecting Pollinators: Why and How Pesticide Applicators Can Help Them
- Plight of the Pollinator: Solving Your Pest Problems Without Harming Pollinators
- Plight of the Pollinator: Save Money, Time and Energy with IVM and Energy Rights-of-Way for Wild Pollinators.

Project Apis m.- Information for beekeepers and orchardists including best management practices.

Pollinator Conservation The Xerces Society
Pesticide Considerations For Native Bees in Agroforestry; The Xerces Society fact sheet

EPA Pollinator Protection.-information on bee death, and reporting bee incidents

CURES Coalition for Urban/Rural Environmental Stewardship Pollinators and Pesticide Stewardship Booklet

Natural Resources Conservation Service (USDA NRCS): Insects & Pollinators

Bee Health. Contains a brochure on Honey bee care: Challenges and solutions.

Reducing the Risk of Pesticide Poisoning to Honey Bees. Beekeeping Note 2.12. NC State.

Preventing Bee Kills From Pesticides; Note to Tree Fruit Growers. Washington Dept. of Agric.

Protecting Honey Bees From Pesticides; Alabama Cooperative Extension

Protecting Honey Bees From Pesticides; Ohio State University Fact Sheet #HYG·2161·97

Protecting Honey Bees From Pesticides; The Institute of Food and Agricultural Sciences (IFAS)

Protecting Bees When Using Insecticides; University of Nebraska, NebGuide

How to reduce bee poisoning from pesticides-Oregon State University - Discusses causes, signs, and symptoms of bee poisoning; state regulations regarding bee protection.

How to Protect Honeybees from Pesticides: Clemson University

Managing Alternative Pollinators (170 page SARE/NARES publication)

Mid-Atlantic Apiculture Research and Extension Consortium website - Guide to bees and beekeeping from Pennsylvania to Virginia

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NAPPC Initiative (Laurie Adams)

- Pesticide Applicator's Continuing Education Credit Module (3 hrs.)
  - Video (English and Spanish)
  - Workbook
  - Teacher training manual and webinar
- National Reach (grant funding sought)

Protecting Pollinators (sample reel)

- YouTube

Pesticide Environmental Stewardship Website

http://pesticidestewardship.org

Reviewers and input needed:
wayne_buhler@ncsu.edu
919-515-5369

Certification and Training Programs

- Conduct 20 “Pesticide Schools” each year
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