Safety First When Applying Pesticides Use Pesticides Responsibly!

UGA Pesticide Safety Education Program

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Learning Objectives

- Remember the dangers involved when working with pesticides
- Recognize the importance of surveillance, monitoring, product rotation, and other resistance management techniques for maintaining your products' effectiveness
- Understand the importance of safety when handling, measuring, mixing, applying, storing, and disposing of pesticides

Why Are Pesticides Dangerous?

- Pesticide: any material that is applied to kill or regulate pests
 - Insecticides (includes adulticides & larvicides), insect growth regulators
 (includes hormone mimics), pheromones
- Advantages: they are fast, effective, easy
- Disadvantages: all are poisons!

 Harmful to us, non-target organisms, and the environment Choose the least toxic chemical that gives you the desired level of control with a minimal risk of resistance developing!



Your Responsibilities!

- Protecting yourself, others, & the environment
- Applying the pesticide effectively following label directions



Keep a Spill Kit Nearby! Whenever you mix, measure, use, or handle pesticides, including in storage areas, application site, cleanup site, and in transport vehicles



Integrated Mosquito Management (IMM)

A system to control pests that combines several pest control tactics into a single plan to reduce mosquitoes and their "harm" to an acceptable level





- Mosquito identification, monitoring and surveillance, action thresholds
 - Habitat modification (drain ditches, dewater abandoned swimming pools)
- Vegetation management, empty tires
- Biological control (mosquitofish)
- Mechanical barriers (window screens, bed nets, etc.)
- Chemical (pesticide) control





Additional IMM Techniques

- Public education & action (empty standing water; report abandoned pools; discarded tires; sighting, biting, & illness reports)
- Adult & larval surveillance, sampling (pool to test for arbovirus as appropriate)



IMM: Identify Your Mosquito Pest!

- By knowing the mosquito's identity and its ecology and life cycle, you:
 - Make your job easier
 - Save money
 - Make it more likely you'll succeed
 - Keeps you from unnecessary exposure

You should:

- Control only when pest numbers exceeds your set action threshold — derived from:
 - Biting complaints/phone calls
 - Positive arbovirus report
- Use strategies/methods that cause minimal harm

IMM: Monitor the Mosquito Pest

- Use surveillance, trapping, weather data, models to assess and predict
- Action threshold exceeded! Population level is unacceptable – do something!
- Sometimes the action threshold may be very low!

 Action needed if WNV, EEE, or other arboviruses (Zika, dengue, Chikungunya) are detected

 Action thresholds vary by mosquito species, site, weather, and season

Action Threshold



Time

Public tolerance level may vary by awareness, news reports, etc.

Action threshold is based on public health triggers.

Ask at what point does my cost of control ward off future expenses?

IMM: Choose Your Goal

- Prevention: sanitation, exclusion, pesticide treatments
- Suppression or reduction: sanitation, biological control, public education, pesticides
- Eradication or elimination: unrealistic goal for species; arbovirus infection?



Considerations for Pesticide Use

- Species identity is known
 - Alternate control methods ineffective
 - Appropriate product/method selected
 - Susceptible life-stage identified
 - Adult control or larval control
- Use the minimum / correct application rate for control; monitor for effectiveness & adjust rates
- Prevent resistance development in mosquito populations
 - Rotate mode of action frequently





How Do Pesticides Vary?

- Mode of action: how the pesticide works to control the pest
 - Systemic pesticides are absorbed through tissues and transported elsewhere where the pest encounters it through feeding
 - Used on plants or livestock (ivermectin)
 - Contact pesticides must come in direct contact with the target pest (malathion and naled)

Pesticides Also Vary By...

- Selectivity: what range of pests they affect
 - Non-selective kills all related pests another term is broad spectrum so they'd kill mosquitoes and a lot of other related non-targets, some of which may be beneficial!

 Selective – kills only certain species – an example is *Bsph*, which kills mosquito species in only certain genera (*Culex* and *Anopheline* in this case)

And Pesticides Vary By...

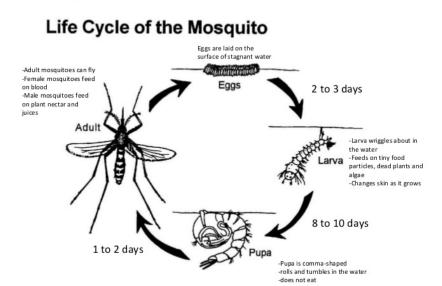
- Persistence: how long they remain active in the environment
 - Residual pesticides remain active for days weeks, or a month or more, ex. *Bt* in slow release tablet or granule formulations will kill for an extended period of time
 - Non-residual inactivated immediately or within a few days for example, some *Bt* products like
 Vectobac will be deactivated in a few hours and not control newcomers (flying in from non-treated areas) or hatching pupae

Pest Resistance Development

- Complicated by pests with rapid life cycles, e.g. mosquitoes, biting flies
 - These have multiple generations in a year and can "amplify" resistance conferring genes
 - Resistance more likely to develop if population is <u>high</u> when chemical control is initiated

Life Cycle of the Mosquito

The following picture shows the life cycle of a mosquito. There are four stages altogether : (1) eggs, (2) larva (3) pupa and (4) adult.



Pesticide Resistance

- Organophosphates (OPs) and pyrethroids most used adulticides
 - They kill mosquitoes in slightly different ways <u>but</u> are detoxified by P-450 enzymes so shared resistance can develop
 - Naled and malathion are OPs; they inhibit cholinesterase enzyme (loss of coordination, paralysis, and death)
 - Permethrin, resmethrin (RUP, cancelled Dec. 2015), d-phenothrin (sumithrin), allethrin are pyrethroids; they keep sodium channels open (nervous system paralysis)

OP & Pyrethroid Resistance

- Do not continue use after there's evidence of resistance development
- Will see increased activity of mosquito P-450 detoxification enzymes, which leads to:
 - Increased degradation of the insecticides
- Long-term resistance is possible
- Pyrethroid resistance already seen in some populations

Pest Resistance

 Chemical solution to resistance is to use alternate modes of action to break the cycle!



- Rotate between adulticides and larvicides
- Rotating mode/site of action from one year to the next does <u>not</u> prevent resistance!

Pesticide Resistance

- Microbial larvicide MOAs (*Bti & Bsph*)
 - Both disrupt, paralyze, and rupture the gut, but bind to chemically different receptor cell sites
 - Bsph most active against Culex and Anopheline larvae; less active against some Aedes larvae
 - Bsph kills more slowly (2-3 days vs. hours) but gives longer residual activity (recycling)
 - *Bsph* can and has seen resistance development
 - Combining with *Bti* can bring back *Bsph* susceptibility in *Bsph* resistant populations

Pesticide Resistance *Bti* (>30 years of Public Health Use)

- No cases of operational-level resistance!
- *Bti* offers intrinsic resistance management
 3 Cry toxins and 1 Cyt toxin in one product
- Low residual activity in open water bodies
- Extremely effective in "clean" water habitats
 - Higher dose needed when organic content is high
 - Kills 1st to 4th instar larvae
 - Requires dedicated site surveillance
 - Apply in appropriate treatment window

Pesticide Resistance

- Spinosad, combo of bacterial products, in Clarke Natular formulations EPA Reduced Risk Pesticide
 – IRAC Class 5 with a unique MOA
- Insect Growth Regulator or IGR MOAs ex. methoprene
 - Disrupts mosquito larva's hormone-mediated developmental processes
 - High levels of resistance arose after 20 years of heavy use; a methoprene-tolerance gene is suspected
 - Partial reversion back to methoprene susceptibility achieved with *Bti* alternated with other control applications (oil + pyrethrums)

The Label Is The Law; Read The Label Before...

- Buying the pesticide
- Storing the pesticide
- Mixing and applying the pesticide
- Disposing of unused pesticide and empty containers



Wear <u>All</u> Required Personal Protective Equipment (PPE)

Minimum PPE for any pesticide application is:

- Long-sleeved shirt
- Long trousers or coveralls
- Gloves
- Shoes plus socks
- Brimmed hat

Protect Yourself!



Your Required PPE Is Determined by...

- The toxicity of the pesticide
- The formulation of the pesticide
- The activity you are performing
 - Measuring, mixing and loading: 1 PPE
 - Applying: less than or equal to that PPE needed for mixing and loading
 - Maintenance operations: minimum required
 PPE

PPE Do(s) & Don't(s)

- Read the label for required PPE
- Hands are most likely route of pesticide exposure



- Wear chemical-resistant gloves when using pesticides that contact your hands
- Replace gloves often
- Gloves can reduce skin exposure by up to 99% when mixing, loading, and applying!



Cotton, Denim, Leather: Absorb Chemicals & Not Recommended for Pesticide Applications!

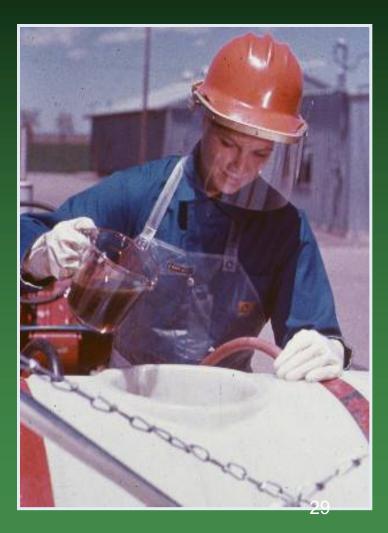


Health Hazards Increase...

• When mixing and loading the concentrate

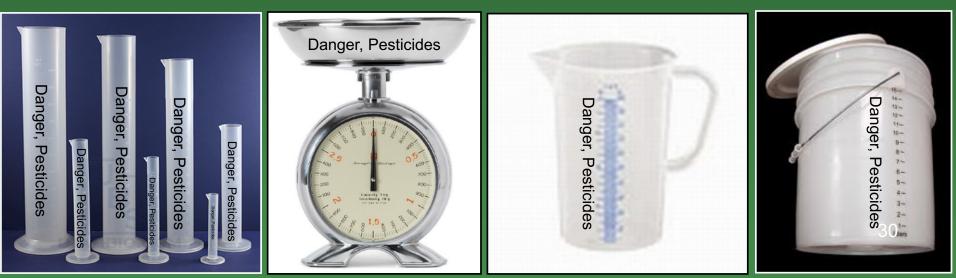
 With a very high single exposure

 After many (low dose) exposures over time



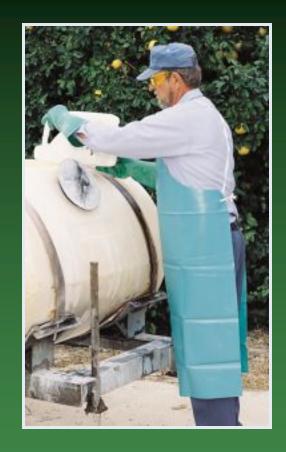
Measuring Container Safety

- Clearly mark utensils used with pesticides
- Never use for another purpose!
- Rinse with diluent; rinsate into mix tank
- Store cleaned equipment in locked pesticide storage area



Safe Mixing & Loading

- Use an accurate scale or measuring device
- Reduce your exposure
 - Stay upwind of vapors and dusts
 - Be extra careful to ensure you do not splash or spill concentrated product



– Pour below eye level!

Never leave the sprayer or filled/partially-filled
 containers unattended
 ³¹

Clean PPE daily and store all PPE separately from pesticides!!



Safe Mixing & Loading

- Clearly mark measuring devices
- Store measuring devices in pesticide storage area
- <u>Carefully</u> open containers
 - Use a sharp knife or scissors to open paper or cardboard containers









Protect Water Sources When Mixing & Loading Pesticides

- Keep the water pipe or hose well above the level of the pesticide mixture
- Consider using a back-flow or anti-siphon device on fill-water supply
- Avoid mixing or loading pesticides in areas near wells, water systems, and surface waters (recommend >100 ft. setback)

Use Proper Mixing Order When Filling Spray Tanks

- 1. ¹/₂ water or carrier (fertilizer)
- 2. Compatibility agent (if needed)
- 3. Suspension products
 - Dry WP, DF, WDG
 - Liquid F, L, ME
- 4. Solution products (S, SP)
- 5. Adjuvants (if needed)
- 6. Emulsion products (EC)





Pesticide Safety Includes the Security of Pesticides

- <u>Unauthorized access</u> to pesticides poses concerns, e.g. accidents, theft, misuse
- <u>Unsecured pesticides</u> pose a danger to all

 Security during transport, application, lunch time, overnight storage

 Transport or storage in an unsafe manner poses threats to human health, animals, and the environment

Store Pesticides Safely!

- Store on sturdy metal shelving
- Place heaviest containers and liquids on low shelves
- Place large drums and bags on plastic pallets/containers
- Seal dry materials in plastic bags and store above liquids



Store Pesticides Safely!

- Store pesticides <u>only</u> in original containers
- Never lend or borrow pesticides in unmarked or unlabeled containers
- Securely <u>close</u> containers when not in use



N0

Read & Follow the Storage and Disposal Section of the Label!

Storage and Disposal

Pesticide Storage and Disposal

Store in a dry place. Do not contaminate water, food or feed by storage, disposal, or cleaning of equipment. Wastes resulting from the use of this product may be disposed of on-site or at an approved waste disposal facility.

Container Disposal

Completely empty bag into application equipment. Dispose of empty bag in a sanitary landfill or by incineration, or by open burning, if allowed by state and local authorities. If burned, keep out of moke.

For minor spills, leaks, etc., follow all precautions indicated on this label and clean up immediately. Take special care to avoid contamination of equipment and facilities during cleanup procedures and disposal of wastes. In the event of a major spill, fire or other emergency, call (919) 292-7100 day or

Precautionary Statements Hazards to Humans and Domestic

CAUTION Harmful if swallowed, inhaled, or absorbed through skin. Do not breathe dust or spray mist. Avoid contact with eyes, skin or clothing. dote for atrazine. If this product is ingested, induce emesis or lavage stomach. The use of an aqueous slurry of activated charcoal may be considered.

Environmental Hazards Atrazine can travel (seep or leach) through

Questions?