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Hard to be Humble: Bigheaded Ants

Managing Insecticide and Miticide Resistance

Coypu, or Nutria, In Florida

Managing Insecticide And Miticide Resistance In Florida Landscapes

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INSECTICIDE RESISTANCE has become a familiar concern for landscape managers. Southern chinch bugs, *Blissus insularis*, have been found resistant to chlorinated hydrocarbons, organophosphates, carbamates, pyrethroids, and neonicotinoid insecticides. The American serpentine leafminer, *Liriomyza trifolii*, developed resistance to several chemical classes after heavy insecticide use in annual bedding plants in the 1970s and early 1980s.

However, we can maintain long-term, effective chemical control through diligent insecticide resistance management. With the limited development of new cost-effective pesticide chemistries, landscape managers need to be good stewards of existing products. Resistance management boils down to reduced pesticide use. Fortunately, there are many ways to do that and still manage the pests that affect our landscapes and lawns.

Important definitions

Resistance — Inherited (genetic) adaptations that allow some individuals to survive and reproduce in the presence of a toxin, which leads to pest control failures.

Cross-resistance — When resistance to one insecticide confers resistance to another insecticide.

Mode of action — The specific physiological effect of a toxin on an insect.

How does insecticide resistance occur?

When a population of insects (Fig.1a) is exposed to an insecticide, most of the insects die (Fig. 1b). But a few survive, and these resistant survivors will reproduce (Fig. 1c). Some of their offspring will inherit resistance to this insecticide. With additional applications of the same insecticide, the majority of the population can become resistant in a few generations (Fig. 1 d-e).

Resistance can develop faster in insects or mites that reproduce quickly, have many offspring, and remain in the same area, like mites, aphids, whiteflies, and thrips. These characteristics often translate to repeated exposure to consecutive pesticide applications to the same pest population, hastening the rate of resistance development.

At the biological level, pests can become resistant to pesticides by changing their physiology or behavior. Some insects may develop ways to detoxify or break down the toxin. Behavioral changes like flying away or hiding during applications may help them by simply reducing their exposure to certain insecticides.

The key to avoiding resistance is to avoid repeatedly exposing a pest population to the same insecticide class, and recognizing high-risk populations. This can be done by following an integrated pest management, or IPM, program and rotating chemical classes, or sometimes using mixtures of different modes of action.

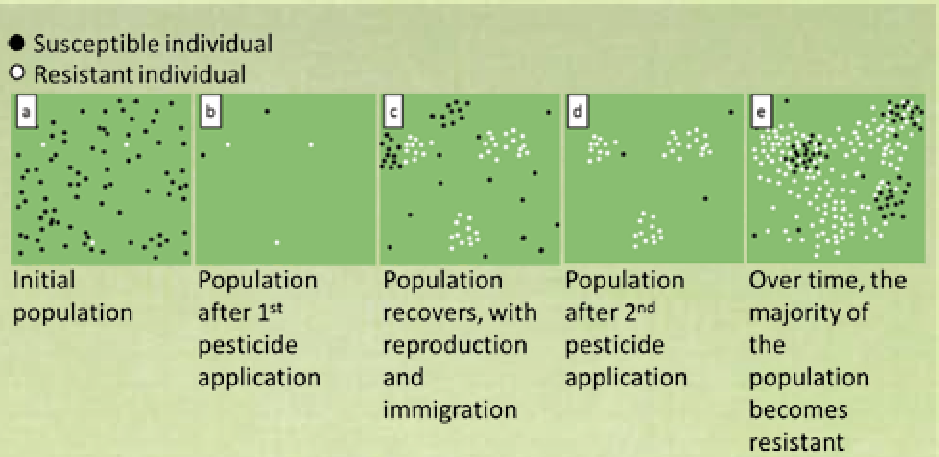

Figure 1. Timeline of insecticide resistance development.

Using IPM to reduce pesticide resistance development

The best way to reduce pest population exposure to the same insecticide is to spray less often! Integrate cultural, mechanical, biological, and chemical controls to control pests more sustainably by promoting plant and ecosystem health.

Guidelines for using landscape IPM

- Sanitation reduces insect pests and diseases. Remove excessive plant debris from flower beds before, and periodically after, installing new plants.
- Inspect plants to be sure they are pest-free before purchase.
- Look for pest-resistant plant species and varieties.
- Rotate species in annual flower beds.
- Follow fertilizer and irrigation recommendations.
- Identify pest species and life stage to help choose the most appropriate pesticide.
- Spot-treat when using pesticides so that natural enemies can recover in untreated areas.
- Use reduced-risk, pest-selective, or biorational pesticides that are softer on beneficial insects.
- Avoid calendar-based spray programs when possible. Spray when pest density reaches economic or aesthetic thresholds.

Insecticide classifications

Insecticides are classified by the way they affect insects at the molecular level, called the mode of action, or MoA. The Insecticide Resistance Action Committee (IRAC) was formed in 1984 and provides insecticide and miticide number and letter designations on all insecticide labels. These numbers are a guide for applicators to incorporate chemical class rotations into their pest management programs.

Some products with more physical modes of action, such as insecticidal soaps and horticultural oils, have no IRAC codes. Their use is unlikely to result in pest resistance, so their rotation is not necessary. However, they are great to incorporate into a rotation program to reduce the likelihood of resistance to synthetic pesticides.

Insecticide class rotation

The objective of insecticide class rotations is to alternate pesticides with different modes of action, so that a single generation of a pest is exposed to only one insecticide class, but the population experiences more than one class over time. This strategy assumes that a pest with resistance to one mode of action (e.g., a pyrethroid) will not be resistant to another mode of action (e.g., an organophosphate).

Rotate the order in which you use insecticides by class if multiple applications are required. Use the IRAC numbers on the label to select a different mode of action each time before returning to a previously-used one. An example of a rotation could be: Talstar [pyrethroid], Purespray Green [horticultural oil] and then Merit [neonicotinoid]. Using products with different active ingredients or trade names will NOT work to avoid resistance development if the active ingredients are from the same chemical class (eg. Talstar = Bifentrhin [pyrethroid], Sniper = Bifenthrin [pyrethroid], Tempo = B-cyfluthrin [pyrethroid], Astro = Permethrin [pyrethroid]).

Keep in mind that rotations should be based only on the IRAC number, not the letter in the classification. Altus [flupyradifurone, Group 4D] is in the same pesticide class as neonicotinoids like Merit [imidacloprid, Group 4A] and Arena [clothianidin, Group 4A]. Therefore, a pest population resistant to IRAC Group 4D is likely to also be resistant to IRAC Group 4A.

Mixtures

Pesticide applicators often appreciate applying mixed pesticides because they can reduce the number of applications and/or broaden the spectrum of pest control. There are several commercial products sold as mixtures for use on turf and ornamental plants, including Allectus (bifenthrin and imidacloprid) and Triple Crown (zeta-cypermethrin, bifenthrin, and imidacloprid).

Simultaneously applying a mixture of active ingredients and insecticide classes exposes pests to more than one toxicant. This strategy may mitigate or delay resistance development, if there is no cross-resistance between the products, if the products have similar residual periods, and if some of the population remains untreated.

However, mixtures should be part of a rotation with other chemical classes. Although these mixtures include multiple modes of action, repeatedly applying them is not considered a rotation and may encourage resistance to multiple classes over time.

Pesticide applicators can make their own mixtures unless the product labeling prohibits it. This practice comes with several important considerations. Do not mix products with the same IRAC number. Also, keep in mind that mixing compounds runs the risk of reducing their effectiveness (antagonism) or causing plant damage (phytotoxicity). Check the label to make sure the products are compatible. If you aren't sure, test a small quantity before preparing a tank. Consider using synergists, which are nonpesticide materials that can boost the efficacy of pesticides. A common synergist is piperonyl butoxide, or PBO, which is often added to pyrethroids or pyrethrins.

Is it resistance?

Finally, it is important to realize that resistance isn't always the problem. If you have had failed control efforts, there are a few things to do before ratcheting up the pesticide rate or applying another dose of the same insecticide.

- Monitor the insect population. Damage can linger a while after the insects are gone.
- Make sure you're applying products correctly. Try applying the highest label rate. Check your walking speed, equipment calibration, and wind speed to make sure the correct amount of product is contacting the infested parts of the plant.
- Consider nonionic wetting agents — a type of adjuvant — to increase penetration and coverage onto plant material. Check your water pH and add a buffer to your spray mixture if needed.
- Follow label instructions regarding irrigation, either watering the product in or allowing it to dry.

Know the chemicals you are using, and use all the tools in your toolkit

Be familiar with the insecticides and miticides you're using. Read the product labels and make note of the IRAC classification number. Utilize your UF Extension resources. Be sure that other IPM techniques such as using pest-resistant varieties, appropriate cultural practices, and natural enemy conservation are being implemented to help sustainably control pests in our Florida landscapes.

Resources to help choose insecticides for rotation

- IRAC MoA smart phone app
- IRAC's Insecticide Mode Of Action Classification: http://edis.ifas.ufl.edu/pi121

More information on IPM in landscapes, as well as insect identification, can be found at ufl.edu/EDIS:

- *Managing Insecticide and Miticide Resistance in Florida Landscapes*
- *Landscape Pest Management in Florida*
- *Landscape Integrated Pest Management*
- *Natural Products for Managing Landscape and Garden Pests in Florida*
- *Guidelines for Purchasing and Using Commercial Natural Enemies and Biopesticides in North America*
- *Insect Pest Management on Turfgrass*

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