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Insecticides Resistance their Mechanism

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INTRODUCTION

Resistance as defined by WHO is "The development of an ability in a strain of insects to tolerate dose of toxicant, which prove lethal to the majority of individuals in a normal population of the same species". Few areas of applied entomology have advanced as rapidly or received such widespread attention in recent years as that of insecticide resistance.

Cross Resistance:

Cross Resistance is the mechanism when the species confers resistance to two or more compounds and this involve the same gene showing resistance to different chemicals**.** Cross resistance involves compound having the same mode of action or similar metabolic pathway. Example The pest conferring resistance to DDT,generally shows resistance to its analogs like DDD but not to cyclodienes (Endosulfan) and lindane which have different cross resistance mechanism.

Multiple Resistance:

When different resistance mechanism exist in an insect it is known as multiple resistance. Multiple Resistance involve compounds having different mode of action . Example The single mechanism in pest secies confers resistance to DDT, cyclodienes and lindane.

Reasons for insect developing resistance

- Continued and frequent use of a pesticide.
- Use of application rates-below or above those recommended on the label.
- Poor coverage of the area being treated.
- Frequent treatment of organisms with large populations and short generation times.
- Failure to incorporate non-pesticidal control practices when possible.
- Simultaneous treatment of larval and adult stages with single or related compounds.

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Resistance Mechanism

What Causes Insecticide Resistance

Insecticide resistance is a reduction in the sensitivity of an insect population to an insecticide. This is reflected in repeated failure of an insecticide to achieve the expected level of control of insects when used according to the product label recommendations and where problems of product storage, application and unusual climatic or environmental conditions can be eliminated as causes of the failure. There are several ways insects can become resistant to crop protection products, and pests often exhibit more than one of these mechanisms at the same time. There are a number of ways insects can become resistant to insecticidal crop protection and public health products:

Metabolic resistance

Resistant insects may detoxify or destroy the toxin faster than susceptible insects, or quickly rid their bodies of the toxic molecules. Metabolic resistance is the most common mechanism and often presents the greatest challenge. Insects use their internal enzyme systems to break down insecticides. Resistant strains may possess higher levels or more efficient forms of these enzymes. In addition to being more efficient, these enzyme systems also may have a broad spectrum of activity (i.e., they can degrade many different insecticides).

Target-site resistance

The target site where the insecticide acts in the insect may be genetically modified to prevent the insecticide binding or interacting at its site of action thereby reducing or eliminating the pesticidal effect of the insecticide.

Penetration resistance

Resistant insects may absorb the toxin more slowly than susceptible insects. Penetration resistance occurs when the insect's outer cuticle develops barriers which can slow absorption of the chemicals into their bodies. This can protect insects from a wide range of insecticides. Penetration resistance is frequently present along with other forms of resistance, and reduced penetration intensifies the effects of those other mechanisms.

Behavioral resistance

Resistant insects may detect or recognize a danger and avoid the toxin. This mechanism of resistance has been reported for several classes of insecticides, including organochlorines, organophosphates, carbamates and pyrethroids. Insects may simply stop feeding if they come across certain insecticides, or leave the area where spraying occurred (for instance, they may move to the underside of a sprayed leaf, move deeper in the crop canopy or fly away from the target area).

Strategies for pesticides resistance management

An Integrated Approach to Insecticides Resistance Management

The most effective strategy to combat insecticide resistance is to do everything possible to prevent it occurring in the first place. To this end, crop specialists recommend IRM programs as one part of a larger IPM approach covering three basic components: monitoring pest complexes in the field for changes in population density, focusing on economic injury levels and integrating multiple control strategies. The best strategy to avoid insecticide resistance is *prevention*. More and more pest management specialists recommend insecticide resistance management programs as one part of a larger integrated pest management (IPM) approach

Economic Thresholds

Insecticides should be used only if insects are numerous enough to cause economic losses that exceed the cost of the insecticide plus application, or where there is a threat to public health. Exceptions are in-furrow, at-planting or seed treatments for early season pests that from experience it is known usually reach damaging levels annually. Farmers are always encouraged to consult their local advisors about economic thresholds of target pests in their areas.

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Monitor pests.

Scouting is one of the key activities in the implementation of an insecticide resistance management strategy. Monitor insect population development in fields (with the assistance of a crop consultant or advisor if necessary) to determine if and when control measures are warranted. Monitor and consider natural enemies when making control decisions. After treatment, continue monitoring to assess pest populations and their control.

Focus on economic thresholds.

Insecticides should be used only if insects are numerous enough to cause economic losses that exceed the cost of the insecticide plus application. An exception would be in-furrow, at-planting treatments for early season pests that usually reach damaging levels each year. Consult local crop advisors about economic thresholds for target pests in your area.

Take an integrated approach to managing pests.

Use as many different control measures as possible. Effective IPM based programs will include the use of synthetic insecticides, biological insecticides, beneficial arthropods (predators and parasites), cultural practices, transgenic plant varieties, crop rotation, pest-resistant crop varieties and chemical attractants or deterrents. Select insecticides with care and consider the impact on future pest populations and the environment. Avoid broad-spectrum insecticides when a narrow-spectrum or more specific insecticide will work.

Time applications correctly.

Apply insecticides when the pests are most vulnerable. For many insects this may be when they have just emerged. Use application rates and intervals recommended by the manufacturer or a local pest management expert (i.e., university insect management specialist, county Extension agent, or crop consultant).

Mix and apply carefully

As the potential for resistance increases, the accuracy of insecticide applications in terms of dose, timing, coverage, etc. assumes greater importance. The pH of water used to dilute some insecticides in tank mixes may need to be adjusted to the product manufacturer's specifications. In aerial application, the swath widths should be marked, preferably by permanent markers. Sprayer nozzles should be checked for blockage and wear, and should be able to handle pressure adequate for good coverage. Spray equipment should be properly calibrated and checked on a regular basis. In tree fruits, proper and intense pruning will allow better canopy penetration and tree coverage. Use application volumes and techniques recommended by the manufacturers and local crop advisors.

Alternate different insecticide classes.

Avoid the repeated use of the same insecticide or insecticides in the same chemical class, which can lead to resistance and/or cross-resistance

- Rotate insecticides across all available classes to slow resistance development.
- In addition, do not tank-mix products from the same insecticide class.
- Rotate insecticide classes and modes of action, consider the impact of pesticides on beneficial insects, and use products at labeled rates and spray intervals.

Protect beneficial arthropods. Select insecticides in a manner that is the least damaging to populations of beneficial arthropods. For example, applying insecticides in-furrow at planting or in a band over the row rather than broadcasting will help maintain certain natural enemies.

Preserve susceptible genes.

Preserve susceptible individuals within the target population by providing a haven for susceptible insects, such as unsprayed areas within treated fields, adjacent "refuge" fields, or habitat attractions within a treated field that facilitate immigration. These

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susceptible individuals may outcompete and interbreed with resistant individuals, diluting the resistant genes and therefore the impact of resistance.

Consider crop residue options.

- Destroying crop residue can deprive insects of food and overwintering sites.
- This cultural practice will kill insecticide-resistant pests (as well as susceptible ones) and prevent them from producing resistant offspring for the next season.
- However, review your soil conservation requirements before removing crop residue.

CONCLUSION

In recent years, biochemists and molecular biologists have established a role at the forefront of such research. Despite our rapidly increasing knowledge of the biochemical and molecular nature of resistance, it seems certain that management strategies will continue to rely largely on "broad-brush" tactics equally applicable to whatever mechanism may be present. Although of relatively recent appearance, insecticide resistance is now very widespread and is being increasingly used as a model system for understanding how organisms adapt to human activity and environmental stress.