Attachment 1 to the 2nd quarter report – ESA SME Liaison work up with ESA input
7/26/11-TER

Insecticide Resistance Terms

Acquired resistance: Resistance which develops over extended periods of exposure (not a very useful term).

Target-site resistance: Selection of individuals with a mutation that results in alteration of the target site, thus resulting in reduced binding of the insecticide.

Artificially-induced resistance: Could be used for lab selected populations (not a very useful term).

Behavioral resistance: Heritable change in behavior that reduces exposure to an insecticide and thereby decreases mortality (due to lack of exposure to the insecticide).

Continuous resistance: An established insect population which is resistant to an insecticide, in contrast to non-continuous which breeds back to susceptibility after a period of time.

Cross resistance: Resistance to one insecticide confers resistance to other insecticides, including those having distinct chemotypes or modes of action. *Resistance to chemicals within the same MOA group is also cross resistance.*

Directional resistance: Development of resistance resulting in an increasing percentage of insects expressing reduced susceptibility towards an insecticide. *Resistance is an outcome of selection, not a mechanism.*

Discontinuous resistance: Development of resistance with a percentage of the insects expressing reduced susceptibility in some portions of the population in contrast to other areas. (*May involve perspectives of either time or space*).

Field resistance: Resistance in an insect population which is derived from repeated exposure to an insecticide, thus with reduced efficacy of field applications, maybe resulting in control failures.

Field-evolved resistance: Resistance derived from repeated exposure from field applications of an insecticide.

Hormoligosis: Stimulating insect reproduction through exposure to sublethal doses of insecticide.

Insensitivity: Reduced sensitivity at the target site, especially for insects not ever affected by the insecticide. (Target-site insensitivity).

Laboratory resistance: Resistance selected from insecticide exposure under controlled laboratory conditions (i.e. artificially induced resistance). *Typically this is done by gradually increasing the exposure dose, and often results in polygenic resistance which is different from*

monogenic or single gene resistance that is most common in field resistance. The development of laboratory resistance does not necessarily predict the potential to develop field resistance.

Low-level resistance: The development of reduced sensitivity levels which may be insignificant to some normal control practices; most likely to be first detected in a reduced length of control period or need to use slightly higher rates.

Monogenic resistance: Resistance due to single gene, as opposed to being controlled by several genes.

Major resistance: Resistance levels which highly impact the economics of the management system, relates to population density.

Mechanism of resistance: Behavioral and physiological changes that occur within the insect, allowing for the development of resistant strains.

Metabolic resistance: Resistance which develops through modified or increased expression of enzymes involved in the metabolism, sequestration or excretion of insecticides.

Mode of action: The insect physiological process, biochemical process and/or molecular target that is affected by the insecticide and by which the insecticidal action occurs. How the insecticide works.

Multi-step resistance: Resistance which develops from mutations across multiple target sites, and where each mutation exhibits an additive effect.

Multiple resistance: Resistance to multiple unrelated insecticides, which is conferred by multiple mechanisms - multiple mechanisms here vs one mechanism in cross resistance. (*Many feel the appropriate term should only be cross resistance*).

Negative cross resistance: An occurrence where resistance toward one insecticide results in greater susceptibility towards another.

Partial cross resistance: An occurrence where the insect develops resistance toward one insecticide and low-level change in response toward another unrelated insecticide. (*Not a very useful term, as resistance levels to each chemical are expected to be different*).

Penetration resistance: A resistant trait which develops from mechanisms that prevent the insecticide from penetrating through the cuticle and/or epidermis into the hemolymph and reaching the target site.

Practical resistance: The level of resistance to where conventional field applications of an insecticide no longer provide acceptable control of the insect pest.

Progressive resistance: see multi-step resistance

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Resistance: The development of an insect strain that is capable of surviving a dosage or dose that is lethal to the majority of individuals of the same species, by means of a genetic inheritable change that has increased in frequency in response to selection, and may impair control in the field.

Resistance ratio: The measure of resistance in an insect population, which is calculated by dividing the LD50 of the resistant population by the LD50 of the susceptible population.

Resurgence: A rapid increase in numbers of a pest that has previously been suppressed by an insecticide. *The earlier concept of resurgence due to elimination of natural enemies may be a bit limiting; we now know that pesticides can alter plant defense biochemical pathways that in turn may increase pest populations not because there are no enemies but because they change the plant physiology that may increase fecundity for example. This has been observed with mites and aphids.* J. Econ. Entomol. 2002 Aug: 95(4):729-32; and 2005 Aug: 98(4): 1144-9

Sequential resistance: Term used to assist with management concepts involving insecticide resistance replacement chemistry. In order to minimize the loss of multiple chemistries, a particular insecticide or class might be used (in contrast to others) which would not preclude the loss of potentially important replacement chemistries if resistance were to occur.

Single-step resistance: Resistance which develops from a single behavioral or physiological alteration. (*Can only be precisely defined at the genetic level by a single mutation.*)

Sustained susceptibility: The inability of an insect to develop high levels of resistance toward an insecticide.

Target site of action: The specific molecule (most commonly proteins: receptor, channel, enzyme, transcription factor), or when unknown the physiological component or pathway that is directly affected by an insecticide.

Tolerance: The natural ability for an insect to withstand insecticide exposure. For synthetic insecticides, this is more commonly due to the metabolic capabilities of a particular species; for Bt toxins it may be due to differences in receptor binding, toxin excretion, etc. *It is important to distinguish it from Resistance because this term "tolerance" has been sometimes used wrongly to indicate low resistance ratios in populations. Tolerance is the estimated (upper) natural range of survivorship of a population, previous to exposure or selection by the toxicant. For example one could say that H. zea is more tolerant than H. virescens to the Cry1Ac Bt toxin. It is inherent to the species.*

References utilized in part:

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