3 Park Place, Suite 307
Annapolis, MD 21401-3722 USA

Phone: 301-731-4535
Fax: 301-731-4538

esa@entsoc.org
www.entsoc.org

The Entomological Society of America Position Statement on Insecticide Resistance Management

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Insects can have a devastating impact on everything from food security to human health. In the United States, an estimated $22.9 billion in crop yield losses due to insect pests are prevented by expenditures of $1.2 billion per year on insecticides and their application.[1] Globally, the World Health Organization estimates that insect-transmitted diseases are responsible for 17% of all infectious diseases, and in 2015 there were 214 million cases of malaria alone with 438,000 deaths.[2] Although nonchemical insect management tactics are also utilized, insecticides remain a critical tool for mitigating insect pests. However, continuous exposure to insecticides with the same mode of action can lead to reduced effectiveness if the insect population develops resistance. Insecticide resistance is a genetically-inherited decrease in susceptibility to an insecticide in an insect population caused by repeated exposure to the insecticide.[3,4] Insecticide resistance can develop in any situation where insecticides are used to control pest populations. Certain insects are more likely to develop resistance due to their biology, genetic predisposition, and their level of insecticide exposure.

Examples of insecticide resistance are found in:

- Aphids, whiteflies, caterpillars, scales, beetles and other agricultural crop pests
- Bed bugs, houseflies, and cockroaches infesting dwellings
- Mosquito vectors of human diseases
- Flies that parasitize livestock
- Beetles that contaminate stored agricultural products

The goal of insecticide resistance management (IRM) is to delay resistance by developing effective resistance management strategies, investigating and documenting emerging resistance problems, and educating stakeholders on best management practices in order to minimize the negative impacts of insecticide resistance on the environment and society.

The effectiveness of IRM strategies to reduce resistance selection pressure depends on the availability of suitable alternative strategies such as effective biological and cultural control methods, and chemical insecticides with different modes of action (MOA).[4,5]

Constraints to effective IRM and recommendations for improvement

Limited availability of insecticide MOA: A limited number of available insecticides may force pest management practitioners to sometimes rely on repeated application of insecticides that are in

the same chemical class. This process greatly increases the probability of insecticide resistance. Greater diversity of effective and affordable MOA are needed to meet ongoing resistance issues; however, new products may not be profitable enough to discover, develop and register.

Identify and minimize regulatory bottlenecks – A streamlined regulatory process that includes reasonable and predictable regulatory requirements and review timelines will promote the timely development of economical, reduced-risk, pest specific insecticides with novel MOA for all uses, especially for specialty crop, livestock, and public health. A comprehensive reevaluation of the current pesticide regulatory process could identify bottlenecks and improve registration efficiency for new insecticides.

Strengthen alternative registration processes – The IR-4 Project is an essential federal program that generates pesticide residue data to support new minor use registrations for specialty crop production, livestock, and human health.[6] These registrations increase the diversity of reduced-risk pesticides available for IRM. In addition to expanding the registrations of new pesticides, IR-4 also generates basic information about pesticide residues and tolerances (Maximum Residue Limits, MRL), a process that sets pesticide use limits on specialty crop commodities. Using these MRL standards, specialty crop growers can ensure their products meet residue standards for domestic and global markets. Improved funding support for IR-4 will be important to close existing budget shortfalls, and to advance pesticide residue research to effectively address the requirements of changing domestic and international regulatory environments.

Availability of resistance detection tools: Early detection of resistance is critical for evaluating the success and making modifications in an IRM program. To date, support of basic and applied projects to minimize resistance development have been limited, and these projects are often implemented through public-private partnerships long after resistance to an insecticide has developed.

Improve methods to detect insecticide resistance – Development of rapid diagnostic tools to detect resistance and improve decision making by pesticide users may reduce widespread resistance development in pests. Expansion of IRM funding sources within existing federal programs (e.g., USDA NIFA, NIH NIAID) will be important to develop and deploy effective diagnostic tools for emerging insect resistance.

Increase support for resistance detection infrastructure – Coordination between public institutions, private companies, and regulators will enable early detection of resistance in key pests of crops, livestock, and humans. Coupled with effective diagnostic tools, support for resistance detection between public and private entities will improve the stewardship of insecticides in the future.

Lack of understanding or adoption of IRM: Education remains a major limitation to the adoption and implementation of IRM strategies. Future IRM recommendations will need to convey the values associated with maintaining product durability as well as best practices and technical causes of resistance development.

Support IRM education – Grower incentives and education about the basic principles of integrated pest management (IPM) and IRM are essential to optimize pest management, including best use

of insecticides, pest monitoring, treatment thresholds, natural enemies, pheromones, and selectivity of insecticides. Continued support of Cooperative Extension, IPM-related research, extension grants programs, and resistance-related Extension projects through the Farm Bill are crucial to improvement of IRM education, outreach, and adoption.

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