General Principles of Insecticide Resistance Management from IRAC

Definitions of Resistance and Resistance Management

Resistance to insecticides is defined as 'a heritable change in the sensitivity of a pest population that is reflected in the repeated failure of a product to achieve the expected level of control when used according to the label recommendation for that pest species' (IRAC). The key to managing resistance is to reduce selection pressure caused by the over-use or misuse, because this could result in the selection of resistant forms of the pest and the consequent evolution of populations that are resistant to that insecticide or acaricide.

Practical Principles of Insecticide Resistance Management (IRM)

Consistent with IPM and ICM principles, IRAC recommends the following resistance management guidelines to keep valuable protection tools working effectively and minimise user costs.

1. Consult an advisor for insecticide resistance management and IPM strategies. Consider the pest management options available and map out a season-long plan to avoid unnecessary applications of insecticides. The best plans are those developed by local experts and farmers and adopted on a regional basis.

2. Before planting, consider the options for minimizing insecticide use by selecting early maturing varieties or varieties that are resistant to insect attack. Manage the crop for “earliness”.

3. Consider an integrated approach incorporating as many different control mechanisms as possible. IPM-based programs will include the use of synthetic insecticides, biological insecticides, beneficial insects (predator/parasites), cultural practices, transgenic plants, crop rotation, pest-resistant crop varieties and chemical attractants or deterrents.

4. Select insecticides with care and consider the impact on future pest populations. Avoid broad-spectrum insecticides when a narrow or specific insecticide will suffice. A wide range of parameters should be considered beyond simply cost and effectiveness. These should include:

   Beneficial insects: Maintenance of beneficials can keep pest populations below economic thresholds, thereby reducing the need for treatments or the number of applications.

   Product class: Follow label recommendations for rotating or mixing products from different classes based on modes of action, not just different brands (see IRAC mode of action classification document). When there are multiple applications per season, use alternate products from different mode of action classes so that only one generation per season is exposed to a class. If feasible, rotate products from different classes from year to year to reduce selection pressure when only one application is being made.

   Rates and spray intervals: Use insecticides and acaricides at labelled rates and spray intervals. Do not reduce or increase rates from manufacturer recommendations as this can hasten resistance development. Monitor subsequent pest levels to gauge control and the success of IRM programs.

Application of products: If resistance develops, the margin for error in terms of insecticide dose, timing, coverage, etc., assumes even greater importance. In the case of aerial application, the swath widths should be marked, preferably by permanent markers. Sprayer nozzles should be checked for blockage and wear, and be able to handle pressure adequate for good coverage. Spray equipment should be properly calibrated and checked on a regular basis. Also, 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 advisors

Tank Mixes: It is often considered necessary to tank mix different chemicals for improved or broader spectrum pest control. If this is to be successful it is important to mix compounds which have different modes of action to maximize pest control and reduce the potential for development of resistance. Where possible compounds should also persist on the crop or surface for similar periods in order to expose insects to both modes of action for the same length of time. Use of multiple products of the same mode of action in the spray tank will do little more than using an increased rate of a single compound of the same chemical class.

Timing of applications: Applications of insecticide and acaricides should be made against the most vulnerable life stage of the insect pest. Care should be taken to follow the recommendations of the manufacturer and local advisors.

5. Watch the pest population during the growing season. Regularly monitor fields to identify pests and natural enemies, estimate insect populations and track stage of development. Insecticides and acaricides generally should be used only if insect counts exceed the local economic threshold or the point where economic losses exceed the costs of insecticide plus application. Time applications against the most susceptible life stages to gain maximum benefit from the product.

6. At the end of the season remove crop residues, as appropriate, to eliminate food sources and over wintering habitats for pests. Consider next years IPM/ Insecticide Resistance Management plans while planning and preparing for next year's crops.

7. Prevention is the best strategy, but if you suspect resistance, first eliminate other possible causes. In many instances, lack of control can be attributed to application error, equipment failure, or less-than-optimal environmental conditions. If these possibilities have been ruled out, work with local agricultural advisors and the manufacturer to confirm actual resistance to the compound applied. In the event of a control failure due to resistance, do not repeat the application with an insecticide of the same chemical class.

Further information can be obtained from the Insecticide Resistance Action Committee or from their website at www.irac-online.org