Tips on Managing Insecticide Resistance in the Greenhouse

Many insect, pathogens and weeds have developed resistance to pesticides. Insecticide resistance is the inherited ability of an individual insect to survive exposure to a concentration of insecticide that is lethal to other individuals that lack this gene. An individual insect inherits this resistance gene from its parents.

In the enclosed greenhouse environment, most of the insect and mite pests have very short generation times, reproducing rapidly with high birth rates. There is usually abundant food in the greenhouse. Many overlapping generations can occur during a growing season. Certain populations of aphids, thrips, whiteflies and spider mites have developed resistance to organophosphates, carbamates and pyrethroids.

Pesticides are seldom 100% effective, so there are always a few individuals that can survive and reproduce. Survivors may have been able to detoxify the pesticide or are immune to the effect of the pesticide or can avoid the pesticide application altogether. If survivors mate and past on this resistance to their offspring, future generations will have fewer susceptible individuals. As time progresses, the entire population may become resistant. The rate at which a resistant trait may spread will depend upon how they gene is passed on to future generations and the severity of the selective pressure. If the selective pressure is high (i.e. when very few susceptible individuals escape and reproduce) resistance will spread rapidly.

Greenhouse growers may use repeated applications of broad-spectrum, persistent insecticides in an attempt to keep insect populations below their low tolerance levels. There can also be a number of reasons besides resistance to explain control failures. The pesticide may have been used at an incorrect rate, may not have contacted the target pest, the population may be too high, or the material could have been leached out of the media or could have been washed off the leaves.

Because of the enclosed nature of the greenhouse, it is less likely that susceptible individuals will enter the greenhouse from outdoors and breed with the resistant populations to contribute susceptible genes to the population. The following suggestions (developed by Dr. John Sanderson, Department of Entomology, Cornell University) can help you develop a resistance management program for your greenhouse.

Minimize Insecticide and Miticide Use. If your pest control program relies exclusively on chemical control, resistance can only be delayed, not avoided. Maximize cultural tactics (sanitation, insect screening, the use of resistant varieties, elimination of weed hosts, use of fallow periods, inspection of incoming plant material, and use of biological control agents and conservation of natural enemies) whenever possible.

Avoid persistent applications. Ideally, an effective insecticide or miticide should be applied at a concentration high enough (following the label directions) to kill all the individuals in a population. The pesticide should then quickly disappear from the greenhouse. Insecticide residues will then not degrade over time to a concentration that will kill only the susceptible individuals within a population.

Avoid tank mixes. When tank mixes are used, the same generation of insects or mites will be contacted by more than one insecticide. This will kill the susceptible pests and often leaves insects or mites that are resistant to both of the chemicals in the tank mix. The continued use of tank mixes will select for those insects that are resistant to both types of pesticides. When one insecticide acts as a synergist for another, for example, adding a pyrethroid to acepthate, tank mixes can be used.

Rotate. The pesticides used in your rotation schedule should have different modes of actions against the pest (i.e. come from different pesticide classes and work differently). Some insecticides are in different classes but have similar modes of action and work in the same way. For example, organophosphate and carbamate insecticides both work in the same way inhibiting cholinesterase. Rotating between pesticides in these two groups will not help you avoid pesticide resistance.

Follow long-term rotations. Use the same insecticide for at least one generation. (A generation is from any stage in the in the insect's life cycle to the same stage in the offspring). If possible, use the same insecticide for two to three generations before switching to a pesticide with a different mode of action. (Many labels will specify how many applications can be applied during a crop cycle). Overlapping generations of many greenhouse pests occur and pesticide residues persist in this enclosed environment. So, many researchers prefer a longer rotation in an attempt to delay the development of resistance. If two different insecticides are used in the same generation, the effect is similar to using a tank mix.

Use pesticides with non-specific modes of action. Insecticide soaps and horticultural oils have broad modes of action, so it is unlikely that resistance will occur. Horticultural oil has been used for over 100 years. So far, there are no cases of insecticide resistance to oil. Adding insecticidal soap or horticultural oil to an effective insecticide may help to delay the development of resistance, as the oil or soap will kill many individuals that are resistant to the insecticide. Before using insecticidal soaps or horticultural oil, spot test first to avoid any potential plant damage.

Integrate biological control and chemical controls whenever possible. Select insecticides that are soft on natural enemies. Many of the newer insecticides are compatible with natural enemies and work well in an IPM program. Learn to recognize the natural enemies that may be entering your greenhouse.

Keep good spray records so you can more easily follow long-term rotations. The following chart lists insecticides and miticides by chemical class to help in your rotation schedule. Use resistant management strategies to extend the effective life of insecticides and miticides in your greenhouse.

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