Suggestions for Managing Insecticide Resistance in the Greenhouse

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Most growers have been controlling pests long enough to have experienced the frustration of using an insecticide that was once very effective only to find it is not working well any more. Conserve insecticide and thrips is a recent example of this occurrence. Insecticide resistance is a major concern for chemical control of almost all of the important greenhouse insect and mite pests. A combination of the biology of the pests, the intensity of chemical use in the past and present, and several aspects of the greenhouse environment and commercial production practices, has led to insecticide resistance problems. The following suggestions should be considered as a part of any chemical control program.

1. Minimize Insecticide Use. If pest control relies exclusively on synthetic insecticides, then *resistance can only be delayed, not avoided*. Therefore, the use of non-chemical control tactics (sanitation, eliminate weeds, soil sterilization, screening vents, natural enemies, etc.) should be maximized. The decision to apply insecticides should primarily be based on pest scouting reports, not a calendar schedule.

2. Avoid persistent applications. Ideally, an effective insecticide should be applied at a concentration high enough (within legal limits) to kill all individuals in a population, then it should quickly disappear from the environment, so that the insecticide residues do not degrade over time to a concentration that will kill only susceptible individuals. For example, aerosol formulations that apply a short "burst" of a high insecticide concentration and do not leave much residue may select for resistance more slowly than full-coverage or systemic applications of the same insecticide, as long as resistance to the insecticide has not already developed in the population.

3. Avoid "Tank Mixes." A mixture of two insecticides may provide superior short-term control than either insecticide used alone, but there is a danger in the long-term use of insecticide mixtures. The assumption behind the use of tank mixes is that if individuals which are resistant to one or the other pesticide in the tank mix are rare in the population, there is little chance that resistance mechanisms to both pesticides would occur together in any one individual. However, if by chance individuals do exist with resistance mechanisms to both chemicals, then continued use of the tank mix will begin to select for these multiply-resistant pests. Chemical control would then become much more difficult, because the pests would be resistant to multiple classes of insecticides.

4. Use Long-term Insecticide Rotations. The pesticides used in a rotation scheme should have different modes of action against the pest and resistance to the chemicals should be at a low (undetectable) level at the start. Organophosphate and carbamate insecticides have similar modes of action and should not be alternated in an insecticide rotation scheme. Use each effective insecticide for at least the duration of one generation of the pest before rotating to a different insecticide. If two insecticides are used within the same pest generation, the selection effect will be essentially the same as using a tank mix. This is because the same individuals would be contacted with both insecticides, although at slightly different times. To minimize the problems of overlapping generations and persistent insecticide residues, it might be wise to use the same insecticide for two or even three generations prior to rotating, if allowed by the label.

5. Use Pesticides with Non-specific Modes of Action. Insecticidal soaps and horticultural oils both have broad modes of action, and it is therefore unlikely that resistance will occur to either of these. In addition, tank mixes of these materials with effective synthetic organic insecticides might delay resistance to the synthetic insecticide, because the soap or oil will kill many individuals that are resistant. However, some tank mixes that include oil or soap may be toxic to certain plants.

6. Integrate Chemical and Biological Control. Many of the newer insecticides are compatible with the use of many kinds of natural enemies. The effective use of natural enemies can add an additional mortality factor that does not select for resistance, and may conserve the effectiveness of insecticides. Effective natural enemies may include predators, parasitoids, and/or insect pathogens. Many extension entomologists and commercial insectaries have information on pesticides that are compatible with various natural enemies. Growers can learn from these sources and their own experience.

Searchable ‘side effects’ lists of compatible pesticides can be found at:

http://www.koppert.nl/e0110.html and http://www.biobest.be/neveneffecten.