

## Editorial

# Insecticide Synergists: Significance and Future

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## INTRODUCTION

There is great need to reduce pesticide inputs to save costs, reduce environmental loads, and lower the selection pressures resulting in rapid evolution. Synergists are among the most straightforward strategies for overcoming metabolic resistance because they can directly inhibit the resistance mechanism itself. They also can be used in understanding the effects of other xenobiotics in non-target organisms [1,2]. The search for and the need of new molecules capable of synergizing existing or new pesticides has reactivated the identification and characterization of secondary plant compounds possessing such activity. Plants do possess and utilize synergists to overcome the damage produced by phytophagous insects. This has to be exploited in pest management programs. Hopefully, it will lead to a new perspective on the nature and significance of synergism. Since the first demonstration of insecticide synergists [3], their effective application against agricultural pests has offered tremendous promise but achieved little utility. This is partly because of difficulties in their use and partly because we have lacked basic understanding of insect detoxification systems. This understanding has been growing, largely because of recent interest in how insects metabolize plant allelochemicals, and the development of new analytical techniques [4,5]. These basic physiological advances and the increased concern over-resistance have combined to bring the possibility of a major role for synergists to the forefront. From a research standpoint, what guidance can synergists provide in our understanding of resistance? From an applied standpoint, how can we transfer recent gains in basic insect physiology and biochemistry to field utility, and what are the operational and biological problems that hinder this transfer? Synergists can play an important role in agriculture and insecticide resistance management, but probably not in the simplistic fashion once envisioned [6,7]. Their value as research tools is well established, but the obstacles to field utility are formidable. At times, these approaches are even in conflict. We have suggested some ideas for circumventing if not overcoming these hurdles, and if they have one feature in common, it is that synergists will have to be integrated into a complex array of interactions between the insect and its environment. We include in this environment natural enemies, secondary pests, host plants, insecticides, and non-traditional control agents. Most insect pests, however, have developed countermeasures allowing them to reverse the inhibition of detoxification enzymes induced by synergists. Still, synergists of increasing specificity remain a major tool in the management of resistant pests. These agents contribute to keep the selection pressure to a minimum level,

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particularly when they act on a unique detoxification route of an insecticide. The role of synergists in metabolic research in insects has become more important. The search for new, naturally occurring synergists represents a major challenge to pest management specialists and toxicologists. The need to control an increasing number of resistant insects, and other pest species, requires the identification of compounds with novel modes of action. These new molecules unquestionably will provide toxicologists with the proper tools for a better understanding of the action of xenobiotics and, consequently, a better protection of non-target organisms and the environment. While there is most likely little hazard of acute toxicity with normal utilization of present synergists, more information is needed to assess the long-term consequences. Paracelsus' statement remains true across centuries: "All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy" (Paracelsus: 1493-1541).

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