

Overview of insecticide resistance problems in arthropods

Ian Denholm

University of Hertfordshire and Rothamsted Research, UK

[\(i.denholm@herts.ac.uk\)](mailto:i.denholm@herts.ac.uk)

Problems being encountered with resistance to chemotherapeutants in sea lice parallel ones that have long been known in other arthropod pests of agricultural, veterinary and medical importance. Resistance has been documented in over 500 species and extends to all major groups of insecticide. Within many species, continued and intensive exposure to chemicals has led to a gradual broadening of the spectrum of resistance, affecting several compound in the same class or unrelated classes of insecticide. The breadth of resistance is determined by cross-resistance, whereby a single mechanism confers protection to several (mostly closely-related) insecticides, and by the appearance of multiple mechanisms in the same individual. The mechanisms themselves can be diverse but most commonly involve either enhanced detoxification by enzymes encoded by large multi-gene families (eg. cytochrome P450-dependent monooxygenases), or a mutation to the insecticide's target site – usually a receptor protein – that reduces toxin binding without altering its normal function. Our understanding of resistance mechanisms is benefiting hugely from advances in molecular genetics enabling genes causing resistance to be identified, cloned, sequenced and their expression analysed far more rapidly than was possible in the past. In many cases, an understanding of the underlying mechanisms has led to rapid-throughput diagnostics for use in large-scale resistance monitoring programmes. The tactics available for combating resistance are frequently limited by practical considerations but invariably entail reducing or diversifying control tactics, e.g. taking advantage of compounds with contrasting modes of action and/or non-chemical options for control. Numerous organisations and initiatives exist to promote awareness of resistance and to co-ordinate the development and implementation of anti-resistance strategies.