Garry Smith

Pheromone Control OF Insects II

Editor's Note: In the last two columns, we have looked at the historical discoveries of insect produced pheromones. In last month's column we looked at the unique properties of these communication chemicals and how they may be used to fight the battle with insects. This month's column looks at the future of pheromone use.

There are many reasons for using pheromones. Pheromones are safe tools for insect control. The fascination of being able to control insect populations through species-specific manipulation of sexual communication, without adversely affecting other, beneficial organisms, has been a driving force for research on insect pheromones for more than four decades.

Will the use of pheromones expand in the future? Will established methods be used on a wider scale and will methods be developed against further insect species? An early and most successful development has been achieved with pink bollworm – but the availability of Bt-transgenic cotton has led to a dramatic decrease in the use of pheromones. In contrast, the surface treated by mating disruption against codling moth in the north-western United States increased from ca. 1.000 ha in 1991 to 45.000 ha in 2000. The use of pheromone will continue to depend on cost and efficacy of pheromones vs. other methods. Failures of mating disruption at high population densities, elevated cost, and the occurrence of other insects which can only be controlled with insecticides are serious obstacles.

Detrimental health effects, environmental issues, insect resistance, or marketing opportunities for organically-produced food are well-known arguments against the use of insecticides. Insecticides do not work as well as often believed, and a long-term population decrease has never been achieved in any species. In comparison, a well-implemented mating disruption program may clearly be more efficient than insecticides in some species.

Many working with mating disruption agree that its long-term use results in continuously decreasing populations of the target species. This may be due to recovery of the beneficial insect fauna and an overall increasing stability of the orchard ecosystem. Resistance against the available insecticides continues to be an important issue. In codling moth, for example, insecticide resistance is increasing all over Europe. It appears to be well known that the overuse of insecticides induces outbreaks of secondary pests such as phytophagous mites, which are difficult to control with pesticides. It has been reported that replacing insecticide with pheromone treatment against codling moth renders treatments against phytophagous mites superfluous, which, compensates for the cost of the pheromone treatment.

Even though we are not always aware of it, environmentally safe control methods are available only against a precious few insect species, and biological control methods other than pheromones are often even more expensive or less reliable than pheromones. It then also becomes apparent that there is great potential in pheromone-based methods, once the "tools" have been developed properly. The tools are the knowledge of the pheromone chemistry and biology of a given species, economic synthesis, appropriate dispensers and the knowledge and experience of how to use them in the field. It was possible to elaborate pheromone-based methods against several species, and with the database on insect pheromones which is available today, it will certainly be possible to extend the use of pheromones to other species.

Economic aspects – Simple equations such as "insecticides are less expensive than pheromones therefore, insecticide use is more economic" are no longer valid. The price of insecticides or pheromones should not be confounded with economy of use. This fact is amplified when pollution of water sources is considered. Also, the consumer demand for unsprayed fruit has steadily increased over the past decade. A leading Swedish supermarket chain has based its marketing campaign on a green image, and all attempts to cut down on pesticide use receive much attention in local and national news media. Pheromone companies need to compete with the price of insecticides, and the amount of active ingredient or the number of compounds formulated in mating disruption dispensers are therefore critical. (Z)-11-tetradecenyl acetate is a pheromone component of many other leaf rollers which are important especially in North America and this compound is easier to synthesize than (Z)-9-tetradecenyl acetate. It is obviously more economic to use one formulation all over and to include single compounds rather than complex blends into dispenser formulations.

Other factors affecting future use of pheromones – One reason for the comparatively limited use of mating disruption is that the technology currently in use must become more reliable. Timing and environment have most often been associated with failure or less than desired results. Already existing knowledge on pheromone technology can be contributed from various disciplines to achieve improvements or to rapidly establish new methods. Unfortunately, lab people all too often lack understanding for the difficulties associated with field implementation work. Field implementation is the focal point of mating disruption research. All available knowledge of an insect's biology, its pheromone chemistry and biology, and dispenser technology needs to be integrated. Lack of success is often equivalent to lack of know how, or the lack of knowledge transfer. Pheromone synthesis, dispensers and dispenser application dictate the cost of mating disruption. Discussions of behavioral mechanisms may turn out to be futile if only we were able to afford or to achieve sufficiently high aerial pheromone concentrations. A major flaw of currently used commercial pheromone dispensers is that they are "passive" and that pheromone release depends on ambient temperature. More reliable and economic applications of communication and mating disruption by pheromone can probably be achieved, and a more widespread use of this technology is not unlikely. SJ