

# Mating Disruption by Pheromones: Resistance and New Direction

Jun Tabata (National Institute for Agro-Environmental Sciences)

jtabata@affrc.go.jp

Most moths use a common reproduction system that involves long-distance attraction of males with volatile chemicals, i.e. sex pheromones, produced by females. Because moths are generally nocturnal and small, mate-finding behavior mediated by pheromones without reliance on visual signals is a rational strategy. To date, a number of studies have analyzed and identified pheromone chemicals from several hundred moths including serious agricultural pest species.

Mating disruption (MD) is a strategy for reducing the population densities of pests by employing the wide scale application of synthetic copies of sex pheromones to interfere with mate location. In a pioneering trial in Japan, a common pheromone constituent of leafroller moths, (*Z*)-11-tetradecenyl acetate (Z11TDA), was used to disturb their mate-finding behavior in tea orchards. The resulting “unnatural” pheromone signals from natural virgin females confused the males’ ability to locate their mates. This was the first Japanese mating disruptant registered in 1983 and was quite successful in maintaining the population density at a low level until the early 1990’s. However, infestations of the smaller tea leafroller, *Adoxophyes honmai*, began to increase again after this time and the efficacy of the control also declined markedly. To elucidate why the disruptant was inefficacious, we investigated pheromone perception of the resistant moths and uncovered that male response to the pheromone blend was markedly extended; the resistant males could locate a synthetic pheromone source even when it lacked Z11TDA that is normally indispensable for attracting *A. honmai* males. Males with the ability to lock on to an off-ratio pheromone blend may be more likely to overcome some of the disruptive effects of pheromone applications [1].

Mealybugs, which also include several agricultural pests, are our next target of MD. The conventional management of mealybugs depends on the regular application of insecticides, but the cryptic behavior, wax-coated body, and clumped spatial distribution pattern of these species render the use of many insecticides ineffective. It is therefore difficult to entirely suppress populations with chemicals. MD is a potential tool that can compensate for the limited efficacy of insecticides [2]. Currently, pheromones are isolated and identified from 15 mealybug species [3]. Although the structures of the hitherto known mealybug pheromones vary among species, some of them have a common structural motif. We focused on this motif and developed some convenient routes to synthesize mealybug pheromones. Moreover, we demonstrated the synthetic pheromones can display MD performance for mealybug populations and opened a way to apply these pheromone mimics to mealybug management programs.

## References

- [1] Tabata J., Noguchi H., Kainoh Y., Mochizuki F., Sugie H.: *Entomologia Experimentalis et Applicata*, 122(2): 145-153 (2007).
- [2] Tabata J., Narai Y., Sawamura N., Hiradate S., Sugie H.: *Naturwissenschaften*, 99(7): 567-574 (2012).
- [3] Tabata J., Ichiki R.: *Journal of Chemical Ecology*, 41(2): 194-201 (2015).