

Mating disruption - an alternative bio-rational control for stored product insects

*Dr M. Nayem Hassan and Dr Shakir Alzaidi

The Pyralid Moths, *Plodia interpunctella*, *Ephestia cautella*, *Ephestia kuehniella*, *Ephestia elutella* are the most wide spread key pests of stored products. The larvae of these moths feed on stored nuts, dried fruits, cereals, legumes, chocolate and other food products, and result in substantial economical loss due to infestation. Current control methods mostly rely on application of insecticides. Recently these pyralid moths have acquired reduced susceptibility to insecticides such as Malathion and Pyrethrin. As methyl bromide has to be phased out worldwide by 2015 and restrictions are imposed on application of insecticides due to human health concerns, an alternative bio-rational pest management system is urgently being sought. One possible solution is the use of pheromone-mediated mating disruption that could be an effective, safe, sustainable, residue-free measure to control stored product moths.

Pyralid male moths utilize an upwind flight system for mate finding via an attractant pheromone released by the female. The mating disruption technique is the most widespread application of pheromones in insect pest management, in which egg laying by the female is minimised or prevented by interfering with or disrupting the successful mating between male and female insects. Although the mating disruption technique has been reported as long ago as 1964, it is only during the last decade that this technique has become established as a successful pest management tool. On field crops, mating disruption formulations are found to be as efficacious as conventional insecticides.

Mating disruption generally requires the use of larger quantities of semiochemicals than does mass trapping and monitoring. This technique is also known as sexual confusion. There are three most likely modes of action involved in mating disruption (Cardé and Minks, 1995):

- Adaptation of the antennal receptors and habituation of the central nerv-

ous system, caused by the continuous exposure of insects to a relatively high concentration of pheromone, which prevents the insect responding to a potential mate;

- Camouflaging of the natural pheromone plume from a calling mate resulting from the use of a high background level of pheromone which renders trail-following impossible;
- False-trail following when a relatively large number of point sources of pheromone are spread around an area to present the pest with many false trails.

The efficacy of this technology is related to the motility of mated females into the area to be managed, the initial population levels of the pest, the release characteristics of the formulation and implementation of a sophisticated management programme. In outdoor field crops, migration of males from untreated areas to an area with a higher pheromone release could decrease the efficacy of the mating disruption. Similarly mated females from untreated areas could enter into the area treated with mating disruption to oviposit. The boundaries of store facilities limit the shortcomings of these outdoor mating disruption methods. An established mating disruption programme could lead the insect population down to below economic threshold levels in raw and processed stored products.

Major benefits of mating disruption

- Non-toxic solution
- Reduces moth reproduction and therefore reduces the number of larvae produced
- Eliminates the need for of space treatments (fumigation)
- Reduces clean-up and shutdown costs associated with traditional treatments
- Continual preventative control strategy

Although most of the insect's pheromone is species specific, several stored products in the family of Pyralidae share a common pheromone component. Female *Plodia interpunctella* produce (Z,E)-9,12-tetradecadien-1-ol acetate as the component sex pheromone. (Z,E)-9,12-tet-

radecadien-1-ol acetate is also identified as a pheromone component of the sex pheromone of *Ephestia cautella*, *Ephestia elutella*, and *Ephestia kuehniella*.

Russell IPM has developed a mating disruption system called Conscent PE containing Z-9, E-12-Tetradecadien-1-yl acetate. Conscent PE is specifically oriented for use in enclosed spaces leading to an increased concentration of the pheromone in the air. It is a steady release solid dispenser that emits the pheromone and induces mating disruption, causing a subsequent reduction of the population of *Plodia* stored product moths.



Conscent PE dispenser to control *Plodia* / *Ephestia*

Conscent PE is designed to be applied year-round and as a part of an Integrated Pest Management (IPM) programme. The pheromone released from Conscent PE seems to trigger the courtship ritual among emerging male moths regardless of the presence or absence of females. Their behaviour is presented as continuous frantic aimless flying and wind fanning. Considering that the Pyralids in general lack well-developed digestive systems and the length of their life is governed by the careful and balanced use of their stored energy, this action seems to be responsible for the rapid loss of energy of the newly-emerging males. It often the case to find male moths sitting on the walls in exposed locations totally incapable of making any movement, yet clearly still alive.

Conscent PE controls *Plodia* / *Ephestia* moths present in stored products by disrupting their natural mating, releasing higher amounts of the sex pheromone so that male moths can not find females to

* Russell IPM Ltd, 68, Third Avenue, Deeside Industrial Park, Flintshire, CH5 2LA, United Kingdom. Email: nayem@russellipm.net

mate. Un-mated females can not produce fertilize eggs, thus the moth population declines rapidly. Once the mating disruption system is in place then the moth population decline proportionately. This system is compatible with other integrated pest management techniques and will not harm the moths' natural predators. Conscent PE allows food processing factories to continue production, rather than shut down for pest control. It reduces the start up and cleaning costs too. The longevity of the Conscent PE dispenser is 90 days from the day of application.



Conscent PE dispenser in use in warehouse.

Effectiveness of Conscent-PE:

Conscent-PE can only work within a strict, well thought out IPM programme. A careful study of the raw material to product flow through the operation has to be analysed. The airflow of the factory also needs to be analysed. Temperature and humidity variations from one zone also need to be noted.

If the pheromone dispensers were to be distributed by taking all the above factors in consideration a zero resident moth population can be achieved after 12 month of continuous application. Pheromone traps showed constantly zero capture, and three-monthly biological assessments indicated the absence of any breeding sites.

Considering that food stores and factories have the inherent risk of getting a new population introduced every time a new raw material enters the building, it is of paramount importance to monitor the process through the factory carefully to identify such an introduction as soon as it takes place. Continuous cleaning of spillages on production lines ensures that this incidental introduction of insects does not develop to a resident population. The product was tested in a real life situation and led to a dramatic decline in reported customer complaints.