Food industry moths always a problem and a challenge

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Plodia interpunctella the Indian meal moth. Photo: Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org

It is universally agreed that almost every area where food is processed will have moths. How great a problem this is will be dependent on the individual company. One company with only a few moths will be very concerned and urgently seeking help, whilst another with a significant moth infestation will claim they don't have a problem. The fact remains the food processing industry will always have a problem of moth infestation even in areas with the highest possible standards of hygiene.

When we talk about food moths they are often referred to as "PE" or "*Plodia ephestia*". There are in fact four moths which are commonly found in the food industry. *Plodia interpunctella* or Indian meal moth, *Ephestia elutella* or warehouse moth, *Ephestia kuehniella* or Mediterranean meal moth and *Ephestia cautella* also known as the tropical warehouse moth.

Plodia interpunctella or Indian meal moth was first described by Hübner in 1825 and gets its common name from the USA where it was found to infest meal made from "Indian corn" or maize. Possibly the most common moth found in the food industry it has been described as the most important pest of stored products. The larva are general feeders and can be found in grain products, seeds, dried fruits, spices and animal food. The life cycle can last from 27 days to 305 days depending on temperature and the availability of food.

Ephestia elutella also known as warehouse moth, cocoa moth or tobacco moth is a small moth probably native to Europe which has spread widely. They are a pest because the larvae feed on dry produce, such as cocoa beans and tobacco leaves, as well as dried fruit, nuts and cereals. Infestations are especially serious where wheat and flour are stored in bulk. Less common foods include dried meat and animal carcasses, specimens in museum insect collections, and even dry wood.

Loosely sealed stored food scent attracts the female moth who deposits her eggs nearby and the newly hatched larvae crawl in and start to feed. This moth can easily tolerate nicotine, so it is also one of the most serious pests in the tobacco industry.

Ephestia elutella larvae infestation initiates contamination of foods by the silk which they produce, which may end up in packaged product or in extreme cases block factory and mill machinery.

Experts dispute the origins of the Mediterranean meal moth *Ephestia kuehniella*, which is now found in temperate areas worldwide. Although its name implies a European origin, some experts believe it came from Central America. First reports of this pest species in North America date to 1889. This species is sometimes confused with the very closely related Indian meal moth *Plodia interpunctella*, which also inhabits pantries and grain storage areas.

Ephestia kuehniella are found in households as well as mills, warehouses, and processing plants. If left uncontrolled, the species may reach extreme population densities in suitable locations, such as mills, and the silken webs produced by the larva may even impair the functioning of flour sieves and other machinery. The larva feed on cereals, flour, baked products and other grain products. Less frequently they feed on dried fruits, mushrooms and occasionally peat and rotting wood may be consumed.

Ephestia cautella or the tropical warehouse moth is a major pest of stored food products worldwide. It originated in the tropics and subtropics but has been dispersed through imported food cargoes.

Infestations have been reported in cereals and chocolate manufacturing facilities. It infests dried fruit and nuts, cereals, oil seeds, oil cakes and chocolate products. This insect species is also known as almond moth or cocoa moth.

The eggs are laid on cocoa, chocolate products, grains, nuts, dried fruits, flour and other plant products. The larvae feed on these food products. Mature larvae leave the product and find a suitable place to pupate. This can be cracks and crevices of cupboards and walls of the storage area. Vacated space may have several life stages of the tropical warehouse moth present. Larvae can chew through foil wrapping and cause damage by contaminating foodstuffs with faeces, webbing, dead moths

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and fungi. Silk webbing produced by the caterpillars can block machinery of flour mills and food processing plants.

Almost every area where food is processed packaged or stored may have moths. Most areas will have a monitoring system such as pheromone glue traps or funnel traps with a pheromone lure. For many years the only treatments have involved the use of poisons either by fumigation with poisonous gas or by spraying with pesticides. Today more and more companies in the food industry are moving away from poisons and demanding non-toxic solutions.

Dismate PE is a non-toxic treatment for the food moths *Plodia* and *Ephestia*. The product was first used in the UK in 2001. A large breakfast cereal manufacturer decided they no longer wished to have insect poisons in their factory and Russell IPM were approached to find a solution. After many years of trials Dismate PE was finally launched in 2010 and is now used around the world in food premises large and small.

The colour coded Dismate dispensers are installed every seven metres and changed every three months. The colour coding loosely reflects the seasons, blue for winter, green for spring, red for summer and yellow for autumn. The pheromone is identical in all four colours but having a colour coded system helps hygiene managers and auditors to identify when units have been changed.

It is very important this density of dispenser is maintained. The pheromone in the dispenser disperses in the air over a period of ninety days. When male moths detect the pheromone, they become confused and excited and begin a so-called mating dance using up their limited energy and dying without mating taking place. As the female must now wait longer to mate, she will lay fewer eggs and the eggs that she does lay will be of poorer quality therefore reducing the moth population.

A monitoring system must be maintained, and it is important to understand that when Dismate is first installed it is possible that more moths will be seen on the wing and the catch in pheromone traps may increase. This phase can last from a few weeks to three or four months and every installation is likely to display this effect to a greater or lesser degree. Following this initial phase, a steady, and sometimes dramatic, decrease in moth activity will occur.

When Dismate was installed in a large chocolate factory dramatic results were seen. Before Dismate was used the company would stop production every thirteen weeks to carry out a deep clean. This was followed by two days of treatment with pesticides and then a further deep clean to remove any pesticide residue. Not only was this procedure expensive but it also caused the annual loss of sixteen days production. During this period of pesticide use the company regularly recorded over 4,000 moths per year in its monitoring traps.

When it began using Dismate the company stopped the pesticide treatments and the deep cleaning but continued with the routine daily cleaning. In the first full year of Dismate use (2011) the moth count fell to 1,825 per year. In the subsequent year the moth count fell again to 434 and by the third year of treatment the annual count was only 113. Graph 1 demonstrates the decline in moth numbers between 2010 and 2013. Similar results have been seen in flour mills and bakeries.

The dispensers in a chocolate factory. Photo: Russell IPM

More recently research has shown a decline in egg numbers in addition to reducing the number of male moths caught in monitoring traps, and there is also anecdotal evidence from factories using the product that there is a decline in customer complaints about moth activity. Using these three data streams (trap catches, egg numbers and customer complaints) we believe we can conclude that the Dismate pheromone system is a highly effective non-toxic treatment for the control of food industry moths.

The dispensers must be installed every seven metres and the system is not a substitute for good hygiene, indeed it may be necessary to educate the end customer about good hygiene before installation. The dispensers need to be changed every three months and a monitoring system must be maintained to ensure accurate documentation of pest levels in the factory as well as to identify problem areas where extra action may be required. ■

Graph 1: Reduction in moth trap counts from 2010 to 2013 at Chocolate Factory site.