SOME ALTERNATIVES TO PESTICIDES FOR MANAGING MOTHS THAT INFEST CEREAL PRODUCTS

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The infestation of cereal products during storage, by moths and other insect pests, has plagued mankind for generations. Conventional pesticide intervention has provided only a temporary respite for managing this insect problem. However, many pesticides used to protect cereal products have been abandoned because of their incompatibility with the storage environment and with the consumers of the products. The development of suitable alternatives to pesticides has been slow, costly and limited.

In our investigations seeking potential alternatives for protection of processed cereal products from Indianmeal moth (and other flour moths) infestation during storage we have examined the moth's responses to alterations in both, its external environment and its internal environment. Our studies have proceeded along three distinct avenues from which we hope to assemble one or more composite programs for managing moth populations in storage facilities without conventional pesticide intervention.

Our **first** approach was to manage moth populations by utilizing the insects own hormonal regulatory system to respond unfavorably when challenged by hormonal agonists placed in their environment. We have available a number of hormone agonists that can effectively elicit behavioral and metabolic responses in moths that affect their growth, development, and reproduction. To protect processed cereals from damage, we felt it was necessary to intervene early in the life cycle of the moth. Therefore, we targeted the developing embryo as a susceptible developmental stage and demonstrated that a single dose of the juvenile hormone agonist, pyriproxyfen, delivered to the egg, either just before or just after laying, prevented egg hatch. Contact treatment of the female and/or the egg could be accomplished with a single surface treatment of the warehouse walls and the outer commodity packaging with the agonist. Freshly processed cereal products were protected from moth infestation for as long as a year. Details of this approach were discussed at the last two MBAO meetings.

Our **second** approach was to examine if consumer-acceptable products can be designed that are not infested by moths during storage. The development of moths on cereal products is influenced by the product's nutrient quality, by its texture and by several other chemical and physical characteristics. During the course of our studies we made the serendipitous observation that some common processed cereal products, e.g. Kellogg's corn flakes, were not susceptive to Indianmeal moth infestation. We have supplemented corn flakes with additional nutrients, greatly improving its suitability for moth development. We are now in the process of identifying these specific nutrients that are critical to moth development. Our aim is to incorporate the corn flake characteristic(s) into other cereal products during processing so as to confer this type of resistance to moth infestation to other products to protect them during storage.

Our **third** approach was to establish a set of environmental conditions in the warehouse space that are hostile to normal moth development so as to impair the infestation of cereal products during storage. We have found that moths respond to changes in light quality, photoperiod, temperature, humidity, air currents and various combinations of these conditions by altering their emergence, mating, egg laying and movements of infesting moth populations in the cereal storage area. Combining two or more of these environmental conditions could provide a tool for managing moth populations in warehouses and markets that would be innocuous to man and animals occupying the same space.

The progress made during the past year on the **second** and **third** approaches will be presented.