TRAPPING AND SPATIAL ANALYSIS FOR PRECISION TARGETING OF STORAGE PESTS IN LARGE RETAIL STORES

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Better methods of population monitoring are needed to facilitate integrated management of stored-product insect pests in large retail stores. Such methods should be capable of detecting insect infestations quickly and of locating the foci of infestation, so that corrective action can be taken with minimum risk of chemical contamination. The methods should be easy and inexpensive to apply, and they must be inconspicuous. Our objective was to develop a monitoring method for Indianmeal moths, *Plodia interpunctella* (Hübner), in discount department stores. Much of the area of these stores is devoted to merchandise that is not susceptible to moth infestation, but the stores also carry highly susceptible items such as pet food, and flying moths can occur anywhere in the store. Because the stores have restaurant facilities, these moths sometimes cause problems with health officials.

We selected three stores for study and used a combination of trapping and spatial analysis of trap counts to produce contour maps which tell us "how many insects are where in each store". The data used in spatial analysis are topographical; that is, each data element consists of two independent location variables, and a dependent or functional variable (number of insects trapped). Thus, a basic requirement for spatial analysis is that trap locations be specified on a two dimensional coordinate system. For our studies, we used a rectangular (x,y) coordinate system with the origin at one corner of the store. The task of actually laying out this coordinate system in a congested discount department store proved problematic, but the problem was solved by taking advantage of certain store features. For example, all of the stores contained numerous, regularly spaced support columns. We determined the x,y-coordinates of these columns and then used them as primary reference points in determining trap coordinates.

Traps with a limited range of attraction are preferred for spatial analysis, because they provide better resolution of an insect population into local components and thus provide a sharper focus on spatial pattern. We used a commercially available low-profile trap (SP-Locator Moth Trap with SP Minimoth pheromone dispensers, Agrisense, Pontypridd, Mid Glamorgan CF37 5SU, UK) designed to locate infestations detected by traps with a broader range. We placed 50 of these traps in each of two stores and 61 in the third, larger store. Ideally, the traps should have been spaced evenly at the nodes of a regular grid, but this is not absolutely necessary, and it is impossible in retail stores, because locations suitable for trap placement are not uniformly available. Also to minimize the number of traps needed, it is desirable to place more traps in areas likely to support insect infestation than in other areas. We distributed our traps as well as possible throughout each store with more in the pet food and grocery sections and fewer in sections such as hardware, electronics and clothing. Traps were attached by Velcro (to facilitate removal for counting moths and replacement afterwards) to the underside of shelves where they were inconspicuous. To assist us in relocating traps, we marked each location with a number on the face of the shelf. We counted the moths in each trap about one hour after the traps were placed and again after 4, 24, 48, 72 and 96 hours.

Spatial analysis of trap counts was performed with Surfer (Golden Software, Inc., 809 14th St., Golden, CO 80401-1866, USA), although other commercially available software could have been used. Trap counts were first posted to a map of the trap locations. Then a denser, regular grid of data points was generated by interpolation using an algorithm known as kriging. Finally, contour lines were drawn at a fixed interval, connecting points with equal values.

Indianmeal moths were detected in all three stores, but the degree of infestation differed. Store 1 showed moderate trap catches in the pet supply section with foci in the vicinity of bird seed and cat litter, although there was no obvious infestation of the products in this area. It appears that the moths may have originated on accumulated spillage under the bottom shelves, but this has not yet been verified. The area under these shelves was hidden by kick plates. With the exception of two locations, no moths were captured outside the pet supply section. Two moths were captured in a nearby section and another was captured far from the pet supplies. The largest focus of infestation in this store was already obvious after one hour of trapping. The pattern of infestation continued to develop over a period of 24 hours, but beyond that time, the pattern did not change significantly. Although the number of moths captured continued to increase over the 96-hour trapping period, no additional information on distribution was gained after 24 hours.

The pet supply section of Store 2 had been cleaned up shortly before we began trapping. No moths were captured the first hour and only one (in office supplies) after four hours. After 96 hours, only three moths had been captured in pet supplies and four in other parts of the store. No trap captured more than one moth and no foci of infestation could be identified. Store 3 showed light trap catches with a focus, already apparent after one hour, in the pet supply section. Although the number of insects continued to increase, the spatial pattern remained essentially the same over the remainder of the trapping period. A few other moths were captured at scattered locations in the store.

Interpretation of trap catch remains an unsolved problem in many trapping applications. The choice between interpretation in terms of population density or interpretation as some risk factor is a choice that must be determined by the objectives of the trapping. Interpretation in terms of population density would certainly be required for studies of population dynamics, but risk factor is often more appropriate for decision-making in commercial situations. In the case of retail stores, we are interested in detecting the presence of infestation and in locating the foci (or sources) so that we can correct the problem by removal of infested products, cleanup or other measures. We are also interested in assessing the effectiveness of treatment by trapping again following treatment. Spatial analysis of trap counts serves both purposes, and no other form of interpretation is required. The information we have gathered thus far suggests that one to 24 hours, and perhaps as little as one hour, of trapping with a sufficient number of well distributed, short-range pheromone traps may be enough to detect infestations of Indianmeal moths and locate foci of infestation.