Tribolium castaneum Behavior near Pheromone Traps

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INTRODUCTION

- Red flour beetle, *Tribolium castaneum* (Herbst) (Coleoptera, Tenebrionidae), is a major stored-product pest of food facilities (e.g., processing plants, mills, warehouses, and retail stores).
- Both males and females respond to a male secreted aggregation pheromone (4,8-dimethyldecanal) and food odors.
- A variety of traps that use pheromone and/or food odors as attractants are commercially available for this species.
- Use of pheromone monitoring programs to precision target pest management is increasing in food facilities, but there are some unique challenges for the interpretation of *T. castaneum* trap capture data:
  - Traps primarily capture individuals that are dispersing, so low capture efficiency can reduce the quality of spatial information generated.
  - Endogenous factors are likely to influence response by individuals to aggregation pheromone and food odors.
  - Exogenous conditions that influence insect movement and response to attractants vary among locations where traps are placed.
- **The goal of this research project is to improve pheromone trap interpretation by developing predictions of insect activity in the vicinity of pheromone traps.**

MATERIALS AND METHODS

- Treatments
  - Male and female red flour beetle adults
  - Two strains: lab strain and field strain collected in a Kansas flour mill
  - No air movement and air movement from the direction of the trap (1.04±0.05 m/sec in release zone)
  - No trap or Dome trap (Trécé Inc., Salinas CA) containing nothing (i.e., empty trap), food oil, pheromone lure, or food oil + pheromone
- Experimental Arena
  - 22 m^2 room
  - Grid of 5 cm squares on floor
  - Release zone and traps along wall
  - 50 by 100 cm observation zone
  - 24.5±0.2°C surface temperature
  - 23.2±0.1°C air temperature
  - 27.0±0.9% RH
  - Room air exchanged between replicates

- Observations
  - Beetles held overnight without food in experimental arena and confined in release zone for 5 min prior to start of observation period
  - Position of beetles was recorded every five sec for 5 min
  - 12 replicates performed for each treatment combination
  - Direction of the trap (left or right) relative to the release zone and the side of the room where traps where placed was varied, but all orientations were standardized for analysis and presentation
  - An additional 24 replicates each of males and females with food oil + pheromone and air movement were observed for 1 hr to evaluate trap capture efficiency

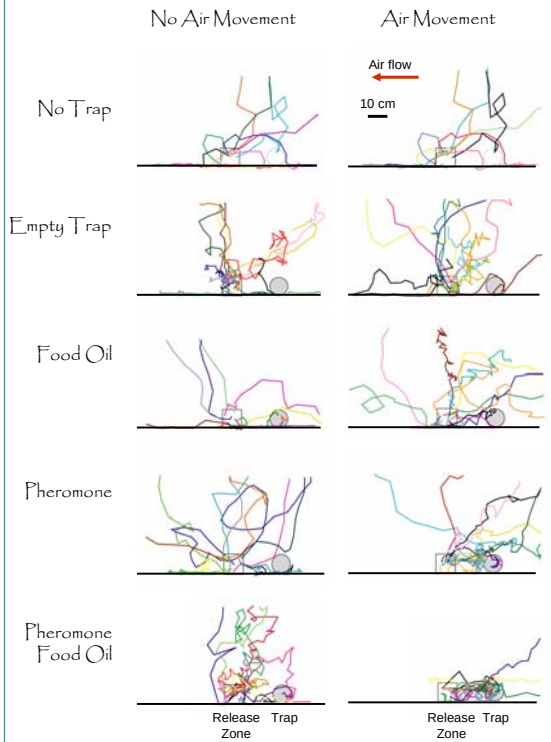

Figure 1 Movement paths of individual beetles after release near traps. Movement paths of individual female lab strain beetles are represented by different colored lines. The thick black line indicates the wall of the arena and the length of the observation zone, the square represents the zone from which beetles were released, the grey circle with black line represents the location of the Dome trap, and white circle with gray outline indicates where trap would have been located in the no trap treatment.

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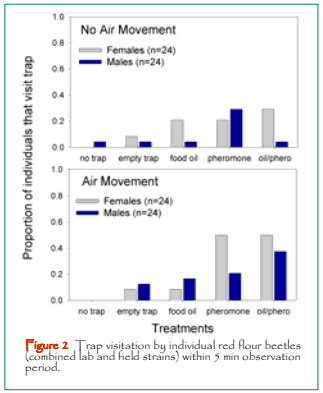

Figure 2 Trap visitation by individual red flour beetles (combined lab and field strains) within 5 min observation period.

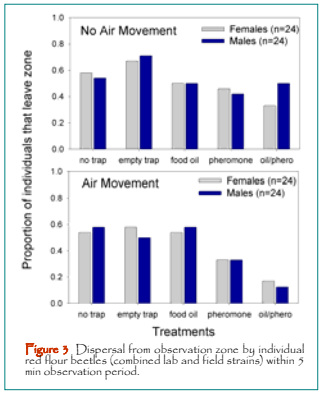

Figure 3 Dispersal from observation zone by individual red flour beetles (combined lab and field strains) within 5 min observation period.

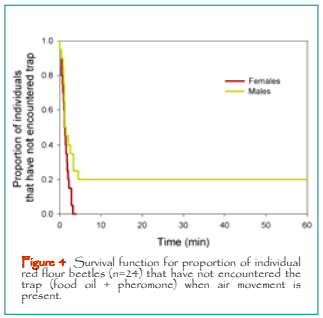

Figure 4 Survival function for proportion of individual red flour beetles (n=24) that have not encountered the trap (food oil + pheromone) when air movement is present.

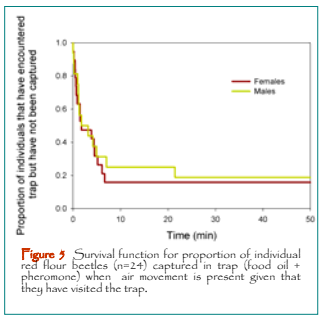

Figure 5 Survival function for proportion of individual red flour beetles (n=24) captured in trap (food oil + pheromone) when air movement is present given that they have visited the trap.

RESULTS

- The strongest directional responses to traps for both females and males occurred with the combination of air movement and food oil + pheromone. Lab strain female data presented for illustration (Fig. 1).
- With air movement, food oil + pheromone traps had the highest visitation rates by both males and females, but females were more likely than males to visit trap with pheromone alone (Fig. 2).
- With air movement, both sexes were less likely to leave the observation zone when pheromone or food oil + pheromone was present (Fig. 3).
- One hour observations indicate that females tend to encounter the traps more quickly than males (Fig. 4).
- The probability of being captured after encountering a trap was high for both sexes; approximately 80% of individuals encountering a trap were captured within one hour (Fig. 5)

CONCLUSIONS

- The Dome trap with food oil + pheromone was efficient at capturing both sexes of beetles after they encountered a trap, but females tended to be more likely to encounter the traps than males.
- Air movement with the trap upstream strongly influenced beetle movement and probability of encountering trap. Many insects obtain directional information from air movement when orientating toward chemical cues.
- In food facilities air movement is often temporally and spatially variable among trap locations. This variation will likely lead to variation in trap capture that is not directly related to variation in pest density.
- The use of spatial information from pheromone monitoring programs for making pest management decisions in food facilities is complicated by these environmental influences on trap capture and need to be taken into account when implementing and interpreting pheromone monitoring programs.