

Greenhouse study on ground beetle movement and predation rate based on habitat type

Elijah Cox¹, Tania Kim²

1. University of Missouri Kansas City Department of Biology

2. Kansas State University Department of Entomology

Introduction

Ground beetles (Coleoptera: Carabidae) are important in agro-ecosystems as generalist predators of invertebrate pests and weed seeds. Predatory ground beetles have been encouraged in crop fields using beetle banks (berms of native grasses and/or wildflowers that harbor predatory ground beetles and other beneficial insects). This has implications for cultural control and ground beetle conservation. However, less is known about ground beetles' cross-over and predation rates between crop fields and perennial grass/wildflower habitats. (O'Rourke, 2008).

Objectives

We have conducted a greenhouse experiment to determine how different plant habitats and planting types would affect ground beetle movement and predation rates.

We chose to look at 3 plant habitats: corn, soybean, and a grass mix planted as monocultures and bi-cultures.

We hypothesize that ground beetles will have increased movement and predation rates in the grass habitat when compared to corn and soybean habitats.

Methods

Two species of ground beetles collected on K-state campus in 10 locations



Scarites subterraneus



Harpalus pensylvanicus

- Marked with paint markers for identification
- Released beetles at the center of each plant tray

Plant trays were created in K-state greenhouses

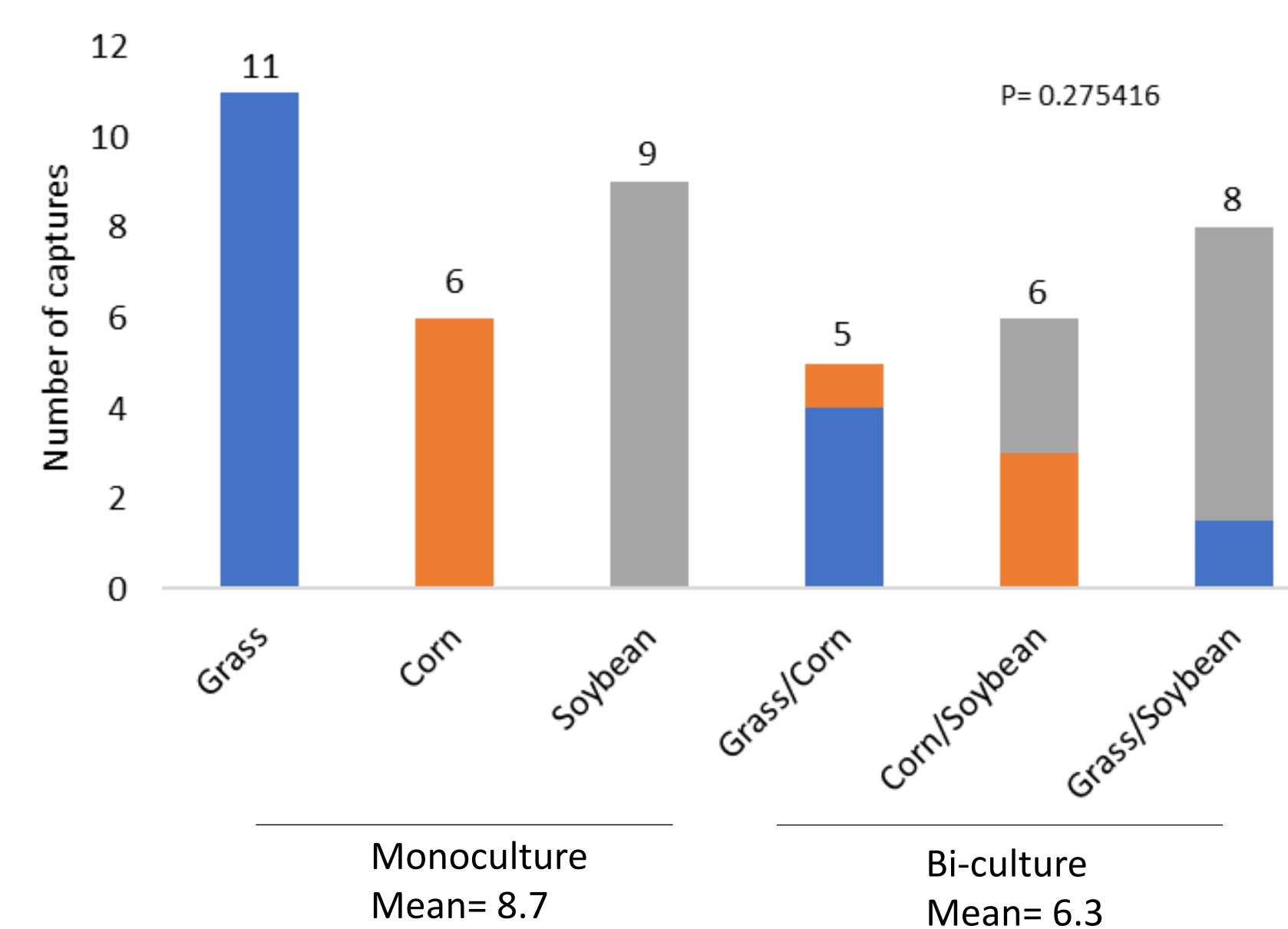
- Created 6 plant trays (18" x 34") with insect containment cages (24" x 36")
- Treatments 1-3: Monocultures of corn, soybean, and a perennial grass-mix
- Treatments 4-6: Bi-culture mix of corn-grass, soybean-grass, and corn-soybean
- Placed 21 pitfalls in grid pattern (3 x 7) in plant trays
- Monitored pitfalls twice a day (AM & PM) for 2-weeks to record the beetles' locations

Fall armyworm (*Spodoptera frugiperda*) moth eggs were used to record predation rates

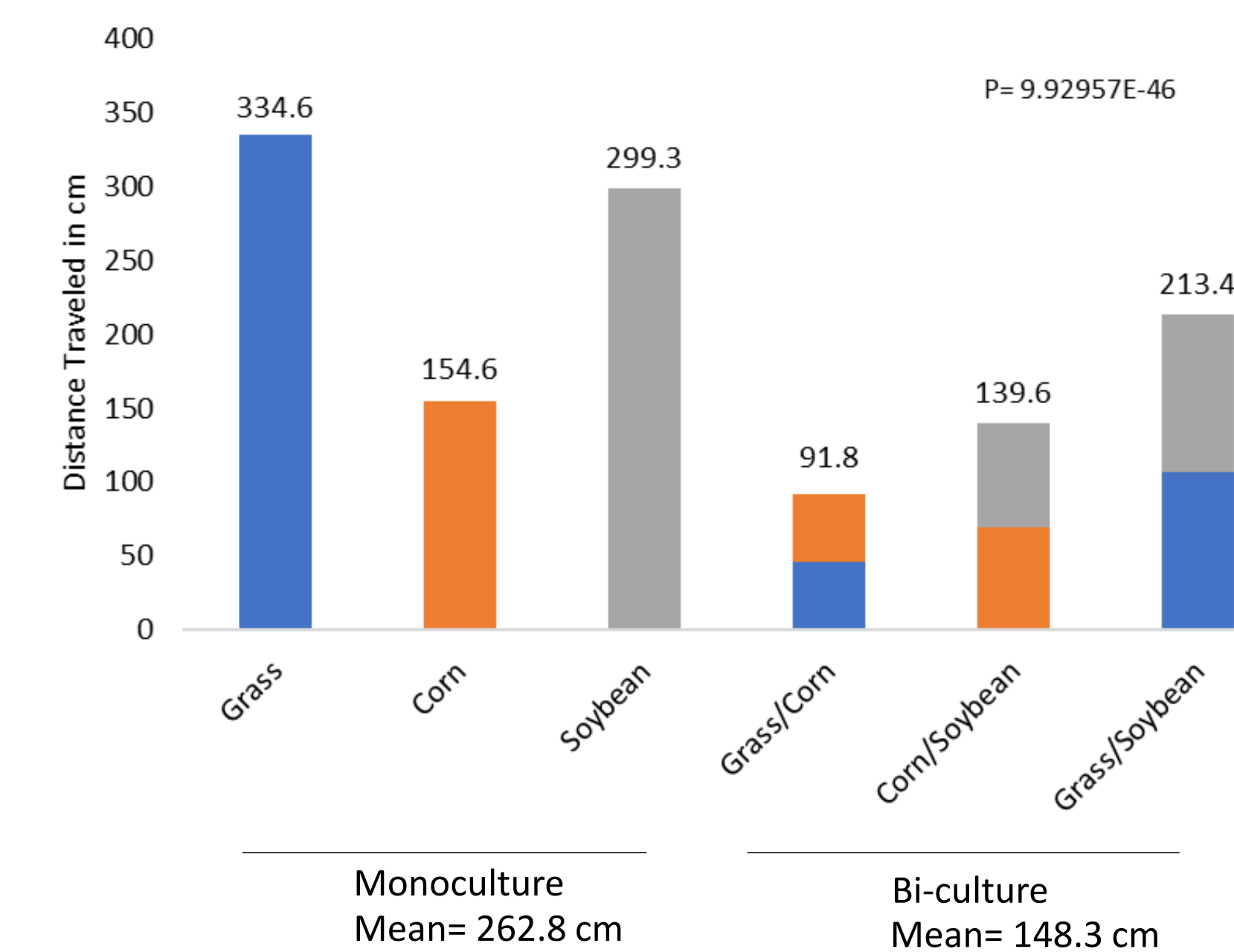
- Created 2" cards with 30-50 moth eggs per card
- Placed 8 egg cards in each plant tray
- Counted egg cards after 5 days

Results

Ground beetles show no habitat preference

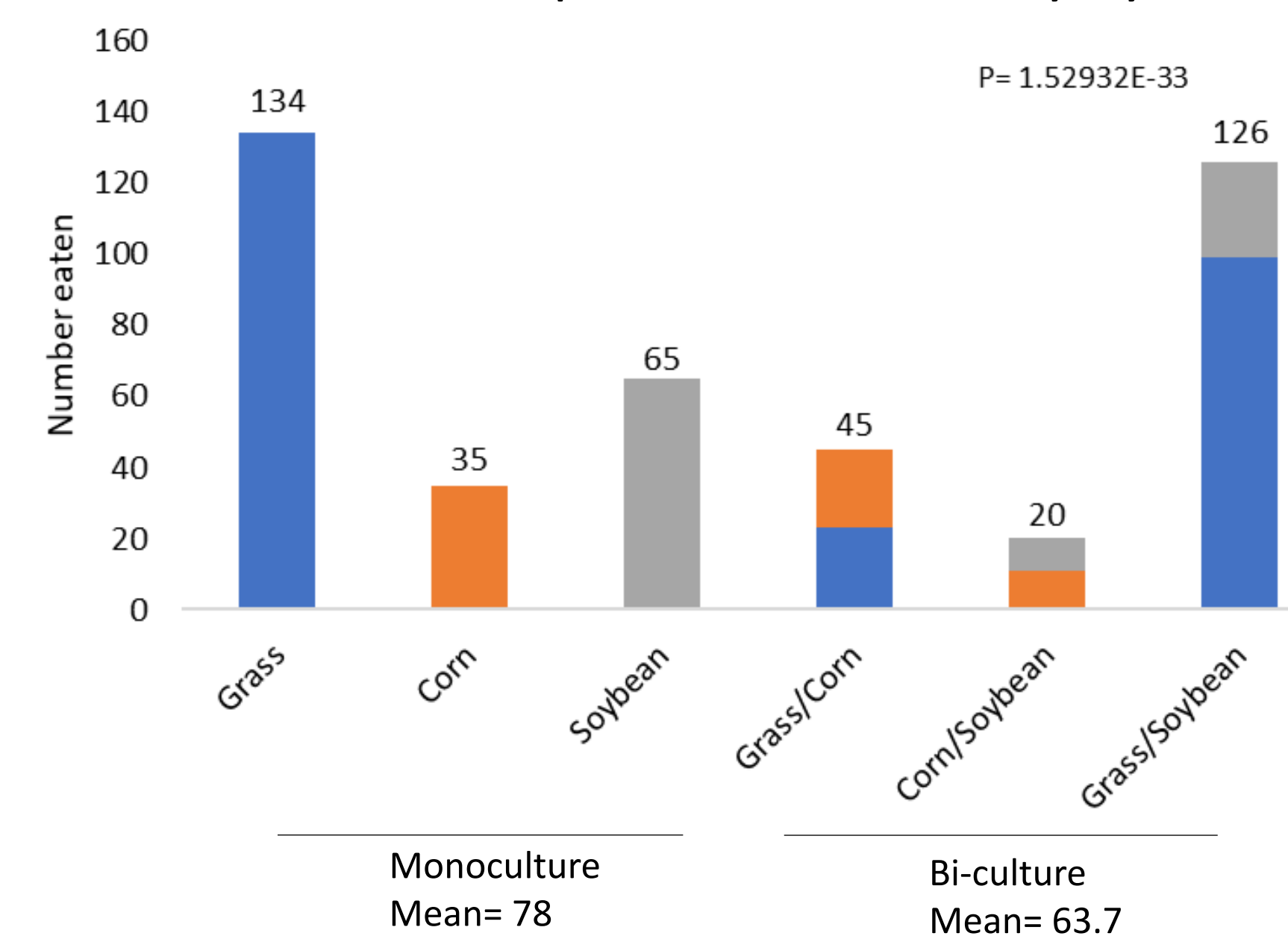


Ground beetle movement varied by habitat type. Movement highest in monocultures; Movement highest in grass and soybean

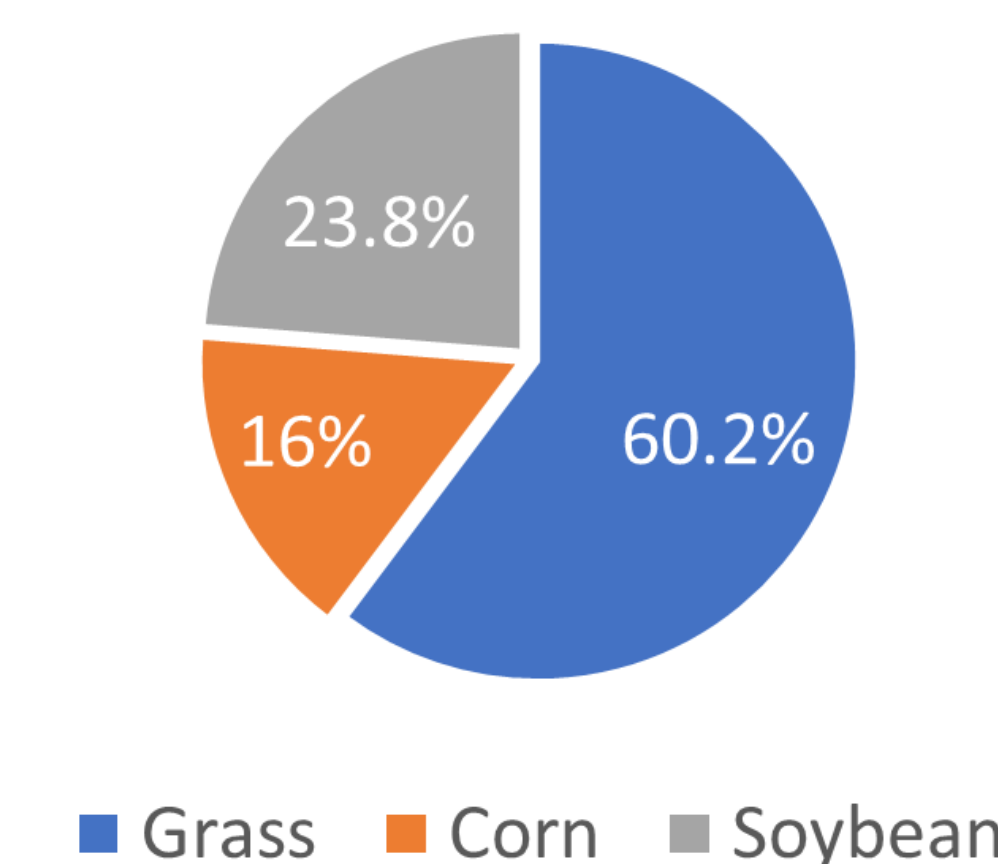


Habitat type affects ground beetle foraging and movement activities

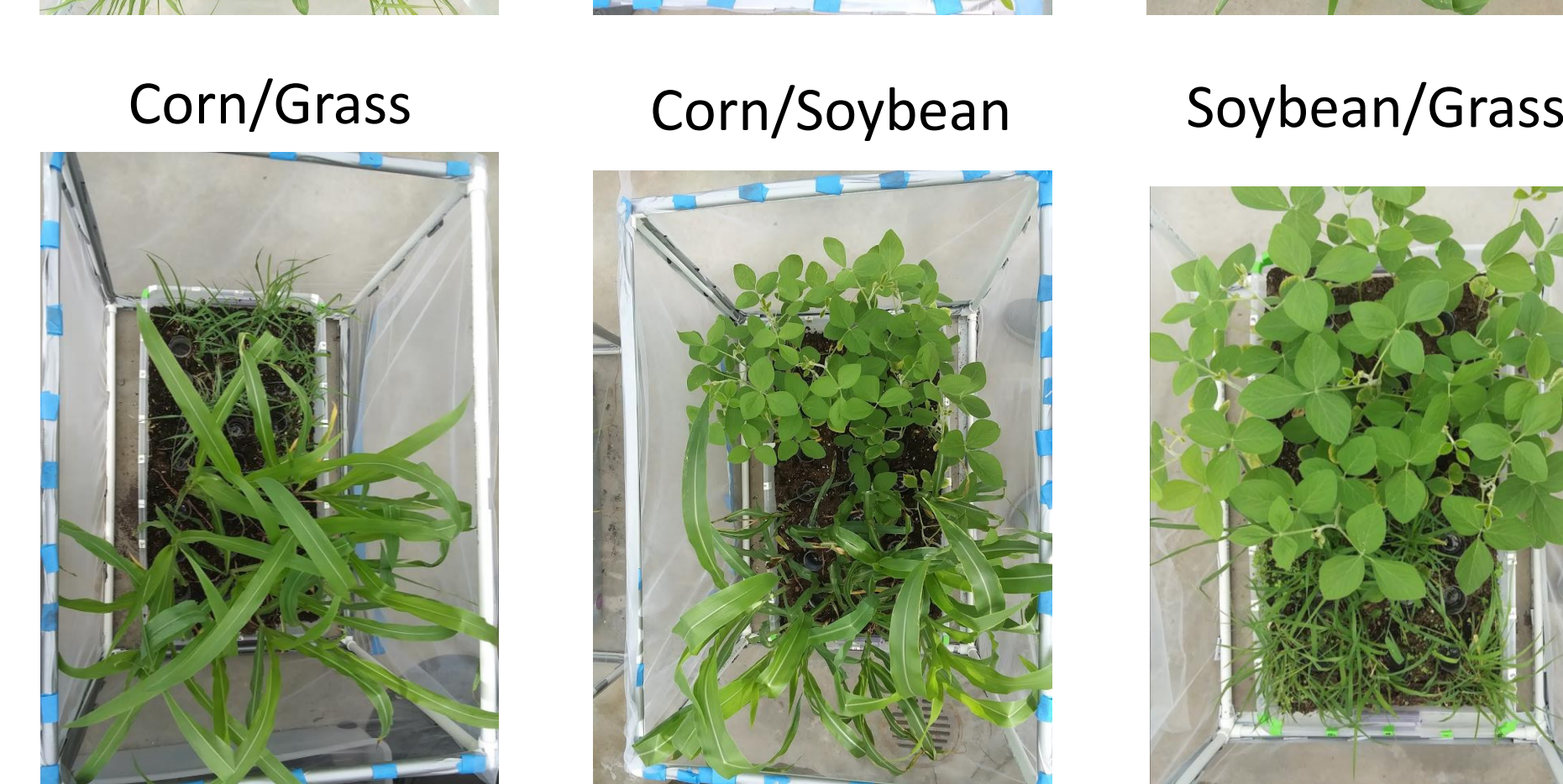
Ground beetle predation rates vary by habitat



Ground beetle predation rates (% eggs eaten) are highest in a grass habitat



Monoculture Treatments



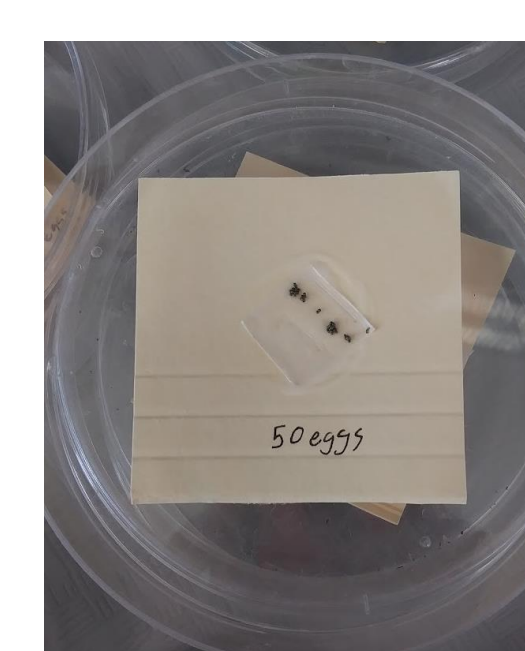
Bi-culture Treatments



Moth eggs



Moth egg card



Spodoptera frugiperda

Conclusions

Habitat type influences ground beetle movement and predation rates. Ground beetles showed higher rates of activity and predation in grass and soybean habitats when compared to the corn habitat.

By better understanding how habitats affect ground beetle behavior we can have a clearer understanding of the ecological role these beetles play in agricultural environments.

Planting type affects ground beetle movement. Ground beetles had higher rates of activity in monoculture plantings compared to Bi-culture plantings.

These results have implications for cultural control practices such as prairie strips and beetle banks for pest management and conservation practices in agricultural systems.

Future Directions

Because ground beetles can be habitat specialists or generalist predators, future studies could determine if ground beetles collected in corn and soybean environments will respond differently to our habitat and predation treatments.

This could help us determine how the species of ground beetle involved affects its feeding and movement behavior.

Future studies could examine how ground beetles would respond to different plant habitats like wheat and alfalfa.

References

- Collins, K. L., Boatman, N. D., Wilcox, A., Holland, J. M., & Chaney, K. (2002). Influence of beetle banks on cereal aphid predation in winter wheat. *Agriculture, Ecosystems & Environment*, 93(1), 337-350.
- Madeira, F., & Pons, X. (2016). Rubidium marking reveals different patterns of movement in four ground beetle species (col., carabidae) between adjacent alfalfa and maize. *Agricultural and Forest Entomology*, 18(2), 99-107.
- O'Rourke, M.E., Liebman, M., & Rice, M. E. (2008). Ground beetle (coleoptera: Carabidae) assemblages in conventional and diversified crop rotation systems. *Environmental Entomology*, 37(1), 121-130.

Acknowledgments

A special thank you to the Kim lab members for their assistance in field and lab work throughout this project. I acknowledge Kansas State University's Department of Entomology and Department of Plant Pathology for their support of this research project. This research was funded by the United States Department of Agriculture-National Institute of Food and Agriculture (USDA-NIFA) under the AFRI Education and Workforce Development grant no. 2019-67032-29071.