

EFAO 2023: Working Research Protocol

Assessment of established beetle banks vs production beds in small scale production for pest control

Farmer-researcher(s): Fianna Dirks, FoodShare - CENTRAL

Project type: Research trial

Research priorities: Disease & pest control

EFAO Contact: Dillon Muldoon

Objective

Does incorporating managed beetle banks (non-crop habitat) into a small scale farm increase beneficial ground-dwelling insects such as predatory beetles compared to monocropped beds?

Background

Burnhamthorpe Collegiate Institute is a 3 acre urban farm using organic growing practices. The site is entering its 4th year of production as a growing space and was a soccer field and green space for the 40 years previous leading to a lot of compaction.

The farm established an orchard a few years ago that incorporated strips of native plants, flowers and grasses. Fianna noticed that the grassy areas, especially those areas that were remedial wood chips have a lot of ground beetles. Further research led them to find that this type of habitat was used to create beetle banks in Europe which came about from the loss of hedgerows and increased pest pressure in fields (Thomas, 2002).

The use of beetle banks has been incorporated into agroecosystems on the west coast of the United States but has not been as prevalent in the eastern United States (Mäder et al, 2014). From the examples found in North America, beetle banks don't appear to be utilized on small scale organic farms and market gardens which are set up for BCS scales.

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Fianna wonders whether incorporating beetle banks into their current operating system can help increase beneficial ground dwelling insects such as predatory beetles for biocontrol on the farm when compared to production beds alone.

References

1. Xerces Society Farming with native beneficial insects Authors Eric Lee-Mäder, Jennifer Hopwood, Mace Vaughan, Scott Hoffman Black, and Lora Morandin
2. Collins, K. L., Boatman, N. D., Wilcox, A., & Holland, J. M. (2003). A 5-year comparison of overwintering polyphagous predator densities within a beetle bank and two conventional hedgerbanks. *Annals of Applied Biology*, 143(1), 63–71.
<https://doi.org/10.1111/j.1744-7348.2003.TB00270.X>
3. 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(1–3), 337–350. [https://doi.org/10.1016/S0167-8809\(01\)00340-1](https://doi.org/10.1016/S0167-8809(01)00340-1)
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5. MacLeod, A., Wratten, S. D., Sotherton, N. W., & Thomas, M. B. (2004). 'Beetle banks' as refuges for beneficial arthropods in farmland: Long-term changes in predator communities and habitat. *Agricultural and Forest Entomology*, 6(2), 147–154.
<https://doi.org/10.1111/j.1461-9563.2004.00215.X>
6. Thomas, S. R., Noordhuis, R., Holland, J. M., & Goulson, D. (2002). Botanical diversity of beetle banks: Effects of age and comparison with conventional arable field margins in southern UK. *Agriculture, Ecosystems & Environment*, 93(1–3), 403–412.
[https://doi.org/10.1016/S0167-8809\(01\)00342-5](https://doi.org/10.1016/S0167-8809(01)00342-5)

Experimental Design

To test the effect of beetle banks, Fianna divided the garden into 3 pairs of plots, for a total of 6 plots. One plot of each pair will have a beetle bank installed (orange) and the other plot of the pair will be the control with no beetle bank (green), as outlined in **Figure 1**.

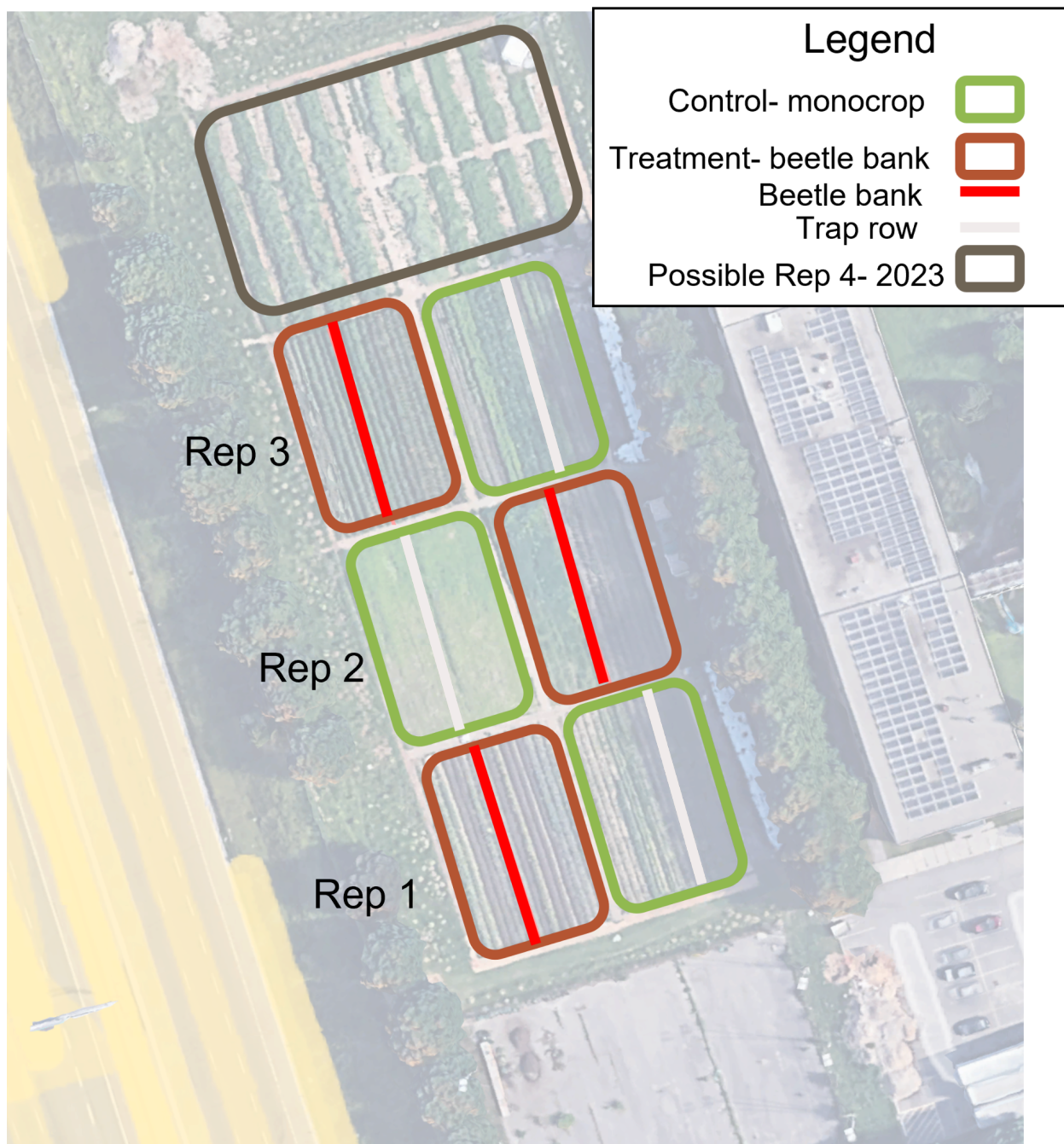
Each of the three treatment plots (orange) will have one beetle bank (red lines; 30"x100ft) which will be made up of 70 per cent native bunching grasses and 30 per cent native flowers. The three control plots (green) will have a control area (gray line; 30"x100ft) that will act as the sampling area.

Each plot is made up of 17x 4ft beds (30" bed 18" path) or (68'x100') the distance between beetle bed and the control plot will be 76 feet (a full section width +8 foot path).

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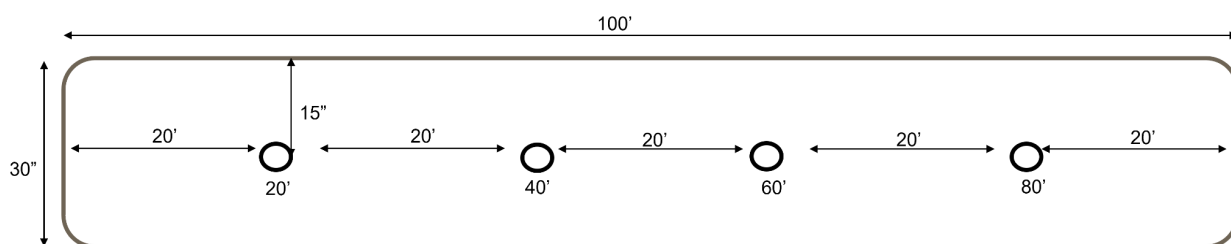
This design will be used to assess if beetle bank habitat increases the abundance, richness and diversity of ground beetles, and other ground dwelling predators compared to a vegetable production bed.

Field Layout

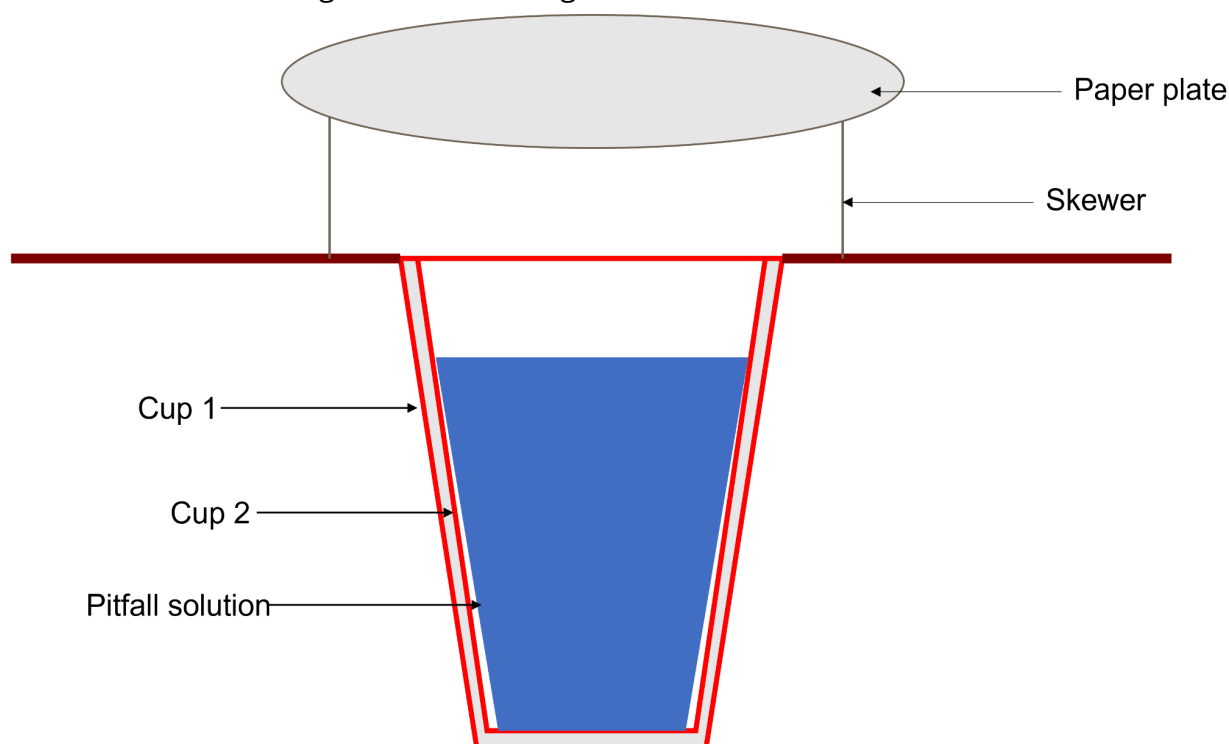


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Figure 1. Three replications of pair control and treatments sites, with a possible fourth replicate in 2023.



Each 100 foot bed for both the control and the treatment will be laid out with the same trapping design, with four pitfall traps in the center of the bed 15 inches from each side at 20 foot intervals starting at 20' and ending at 80'.



Each pitfall trap will consist of two solo cups or other similar cups placed within each other, the second cup allows for easier extraction. This cup will be filled with a pitfall solution (pet

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safe antifreeze or ethyl alcohol) with a cover made of skewers and a paper plate to help keep out rain and other debris.

For each trapping week, pitfalls will be placed out for 48 hours total. The contents of the pitfalls/cups will be collected into labeled bags or containers for future counting and identification. The labels for each trap will be (Rep [1,2,3] - Treatment [C-control, T-Treatment] - Trap# [1,2,3,4]). A-south, D-North

Statistical model

This trial will be a randomized and replicated complete block design; we will use a paired T-Test (or other appropriate statistical methodology) to determine the significance of each measurement among planting dates and between varieties.

Measurements

Quantitative and Qualitative

Crop management records

The following information will be collected on this sheet **once per planting**:

- Seeding date and crop for each trapped monoculture area
- Fertilizer applications (rates, amounts, and date)
- Weed control in trapping plots
- Surrounding crops of monocrop treatment and for beetle bank treatment
- Quardate diversity for beetle banks treatment around traps
- Other notes
- **DATA SHEET**

Trap abundance

The following information will be collected on this sheet **for each sampling week**:

- Total number of ground beetle
- Total number of pest species
- Total number of other identifiable taxa
- **DATA SHEET**

Taxa Identification?

The following information will be collected on this sheet **for each sampling week**:

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- To genus identification?of every ground beetle in the traps?
- To species/genus/family identification?of every pest in traps?
- **DATA SHEET**

Trap richness and diversity if identified for ground beetles?

The following information will be collected on this sheet **for each sampling week:**

- Species richness
- Species diversity
- **DATA SHEET**

Photos

Please take photos of the following times/items:

- Farmer-researches with FLRP sign
- Traps in both field and beetle banks
- Control trapping area
- Beetle bank trapping area
- Trap catches
- Insect identification and counting
- Other

Research Plan

Please note that if data is submitted after the submission deadline, EFAO staff cannot guarantee that your data will be analyzed and written up before the Research Symposium and/or the next growing season.

Time	Task	Methods & Measurements or Action Item
Week of June 12, 2023	Sampling	Traps will be left out for 48 hours. Collect samples from the four pitfall traps in each treatment making sure to keep the contents of each trap separated by trap number and treatment number
Week of June 19, 2023	Sample Identification	Count and identify samples
Week of August 14, 2023	Sampling	Traps will be left out for 48 hours. Collect samples from the four pitfall traps in each

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		treatment making sure to keep the contents of each trap separated by trap number and treatment number
Week of August 21, 2023	Sample Identification	Count and identify samples
Week of October 6, 2023	Sampling	Traps will be left out for 48 hours. Collect samples from the four pitfall traps in each treatment making sure to keep the contents of each trap separated by trap number and treatment number
Week of October 10, 2023	Sample Identification	Count and identify samples
November 1, 2023	Data Due	Make sure all data is sent to EFAO staff
December 15, 2023	Farmer-fee and research expense invoice with receipts for expenses	Submit invoices at this site: https://efao.ca/data/
January/February 2024	Finalize and publish research report	Work with EFAO staff to review polished research report for publication.

Staff check-ins

Dillon will check in monthly during the sampling season.

Materials

Please list all materials, supplies and equipment that will be reimbursed for this project. If possible, please also indicate a short-list of any in-kind materials, supplies and equipment that you will use.

Material	Unit	Quantity Required	Total Cost*	Note
Pitfall trap materials			~\$20	Alcohol more \$ looking for bulk

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				but ~50\$ per sampling date
Native grass and flower seed			~\$280	
Total			~\$300	

Farmer-fee

A \$250 farmer-fee for 2022, and \$500 for 2023 can be collected at the end of each season after all data and photos have been submitted to the EFAO research staff.

Possible next step ideas for monitoring going into 2024:

From there as we discussed there is so much to explore. Distance of predation, species increase over years, sweep netting for other beneficials, does increased habitat space on farm increase numbers. I am also going to do some qualitative work as an extra personal thing with the other farmers making beds in the same area, farm style. Questions such as ease of establishment, working with around, secondary uses of beetle banks, noticeable changes etc.

Something else I was thinking that could be interesting would be to set up pitfall traps in other habitat spaces not specifically designed for beetles, IE shelter belt, windbreak, annual insectary stripe and perennial flower strip to see if specific habitat creation creates an increase in specific species density.

Invoices for Farmer-Fees

Farmer-fee

- Submit an **invoice** for your farmer-fee (email will be sent in September)
- **Deadline:** December 15, 2023

Memorandum of Understanding

Please fill out the MOU at <https://airtable.com/shrc1mclYcx5Aq6Ex>