EFAO
ECOLOGICAL FARMERS ASSOCIATION OF ONTARIO

2023

Assessment of established beetle banks for pest control in small scale market gardens

FARMER-RESEARCHER
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FoodShare, It's Giving Farm

FUNDING

Brian and Joannah Lawson Family Foundation

Robert and Moira Sansom Ideas Foundation, a fund within the London Community Foundation

IN A NUTSHELL

To explore the use of beetle banks at smaller scales, Fianna established a beetle bank in the market garden at Burnhamthorpe Collegiate Institute urban farm. By comparing ground beetle populations in beetle banks and cropped areas, they found:

- There was the same type of ground beetles in the beetle banks and cropped beds;
- There were more ground beetles in beetle banks than cropped areas;
- Beetle banks provided habitat for numerous other beneficial insects in addition to ground beetles;
- Beetle banks provide opportunities for niche enterprises such as cut flowers and mushroom production.

MOTIVATION

Burnhamthorpe Collegiate Institute, part of FoodShare, is a 3-acre urban farm in southern Ontario that uses organic growing practices. A few years ago, the farm established an orchard that incorporated strips of native plants, flowers and grasses. Fianna noticed that the grassy areas, especially where wood chips were present, had a lot of ground beetles.

Research around this observation led Fianna to find out that this type of non-crop habitat was used to create beetle banks in Europe, which came about as a result of loss of hedgerows and increased pest pressure in fields (**1**). This, in turn, can provide natural pest and weed control in the cropped areas (**2,3**).

In North America, there are examples of beetle banks in agroecosystems on the West Coast of the United States (**4**). However, there were limited examples in the East or on small scale farmers or market gardens. In fact, the literature advised that beetle banks are only necessary at larger scales (20+ hectares) where there is homogenous land use (**5**).

After observing more ground beetles in the areas with native grasses at Burnhamthorpe Collegiate Institute, Fianna was curious whether they would see any noticeable effect of incorporating beetle banks at smaller scales within a market farm system.

RESEARCH QUESTION

Does incorporating managed beetle banks (i.e. non-crop habitat) into a small scale farm (<20 hectare) increase beneficial ground-dwelling insects such as predatory beetles compared to monocropped beds?

METHODS

EXPERIMENTAL DESIGN

To test the effect of beetle banks on ground beetle abundance and composition, Fianna established three paired garden areas at FoodShare in May 2022, as shown in **Figure 1**. Fianna established beetle banks in one bed (red line) in the areas outlined in orange. In the areas outlined in green, Fianna established control rows for sampling within mono-cropped beds.

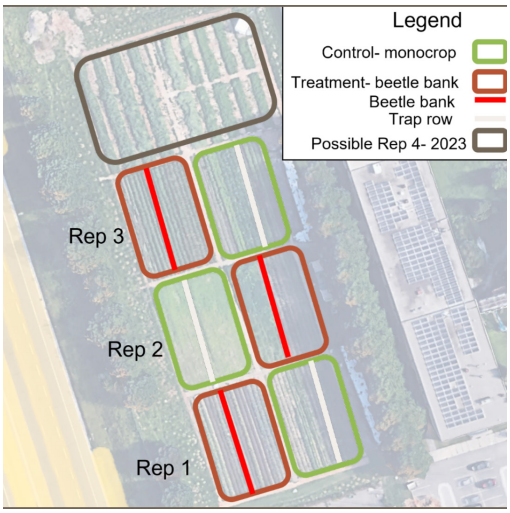


Figure 1. An aerial view of the gardens at FoodShare used for this beetle bank project. Garden areas where Fianna established beetle banks are in orange and areas that were mono cropped without beetle banks are in green. Red lines in the middle of orange beds denote the location of the beetle bank within each plot; white lines in the middle of green beds denote the bed location of the cropped control beds.

Each of the three beetle bank beds (30" wide x 100' long) were centered in one of the six growing blocks, each made up of 17 beds. Three control monocropped beds (30" wide x 100' long) were managed according to the farm's typical practices and were centered in alternating blocks.

BEETLE BANK ESTABLISHMENT

Fianna established the beetle banks by raising the soil of the banks using a rotary plow and then mulching thickly with a mix of mostly hardwood remedial mulch. They then transplanted various species of plugs in 2 bed rows with 12" in row spacing.

The banks consisted of 70% native grasses, including:

- Big Bluestem (*Andropogon gerardii*)
- Sweetgrass (*Anthoxanthum hirtum*)
- Side-oats Grama (*Bouteloua curtipendula*)
- Bottlebrush Grass (*Elymus hystrix*)
- Virginia Rye (*Elymus virginicus*)
- Junegrass (*Koeleria macrantha*)
- Switch Grass (*Panicum virgatum*)
- Little Bluestem (*Schizachyrium scoparium*)
- Indian Grass (*Sorghastrum nutans*)
- Prairie Dropseed (*Sporobolus heterolepis*)

They also contained 30% native flowers, including:

- Yarrow (*Achillea millefolium*)
- Black-Eyed Susans (*Rudbeckia hirta*)
- Coneflower, Purple (*Echinacea purpurea*)
- Blazing Star, Spiked (*Liatris spicata*)
- Prairie Smoke (*Geum triflorum*)
- Mountain Mint (*Pycnanthemum virginianum*)
- Swamp Milkweed (*Asclepias incarnata*)

In the beds on either side of the beetle banks, Fianna rotated crop families and successessions based on their crop plan and previous perennial vegetable plantings in each zone.

The control beds consisted of mono-cropped beds of the following crops:

- Carrots
- Sunflowers
- Bokchoy
- Radish
- Cover Crops pitfall_48hours
- Callaloo
- Zinnia
- Squash
- Cilantro

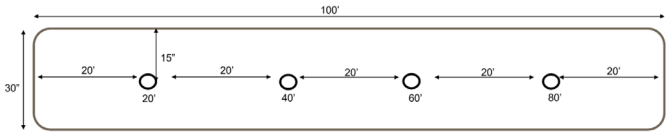


Figure 2. Illustration of the pitfall layout for each of the six beds, which included four pitfall traps in the center of the 30" beds, at 20' intervals starting at 20' into the bed and ending at 80'.

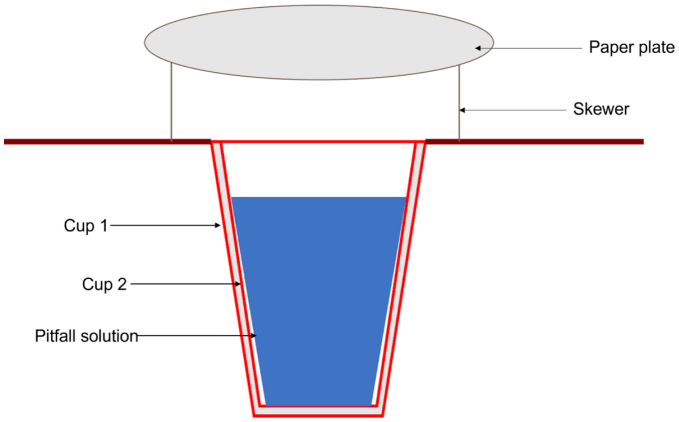


Figure 3. Each pitfall trap consisted of two cups placed within each other (the second cup allowed for easier extraction). Fianna filled cup 2 (the inner cup) with a pitfall solution consisting of ethyl alcohol, and then covered the cup with a paper plate held up by skewers to minimize rain and other debris from falling in the cup.

Example of a pitfal trap in a bed.

Example of a pitfal trap 48 hours after being deployed..

TRAPPING DESIGN

TRAPPING SCHEDULE

In 2022, Fianna trapped the first weeks of August and October. In 2023, they trapped the first weeks of June, August and October 2023.

For each trapping week, Fianna placed pitfalls out for 48 hours total. At the end of the 48-hour sampling period, they collected the contents of the pitfall cups into a labeled container for counting and identification.

DATA COLLECTED

DATA ANALYSIS

This trial used a randomized, replicated paired design and we used a paired t-test with a 90% confidence level to calculate the least significant difference (LSD) needed to call the treatments "statistically different".

Using a 90% confidence level means that if we measure a difference between any two treatments that is greater than the calculated LSD, we expect this difference would occur 90 times out of 100 under the same conditions. In this case, we consider the difference reliable and refer to the results as statistically significant. On the other hand, if we measure a difference between any two treatments that is less than the calculated LSD, we consider these treatments unreliably different or statistically similar.

FINDINGS

In terms of ground beetle community composition, Fianna found the same type of ground beetles in the beetle banks and cropped beds, as illustrated in **Table 1**.

In terms of ground beetle abundance, Fianna found more ground beetles in beetle banks than cropped areas, as illustrated in **Figure 4**. This is similar to longer-term studies that observed polyphagous predator densities in the beetle bank were similar to or greater than those in the conventional hedge banks or fields (**6,7**).

Table 1. Total number and species composition of ground beetles found in crop beds and beetle banks.

GROUND BEETLE SPECIES	TOTAL NUMBER IN CROPPED CONTROL	TOTAL NUMBER IN BEETLE BANK
Chlaenius sp.	8	21
Harpalus pensylvanicus	14	23
Pterostichus melanarius	31	119
Stenolophus sp.	6	11

OTHER OBSERVATIONS

In addition to ground beetles, Fianna observed numerous other beneficial insects in beetle banks that were not present in the cropped areas.

Although the beetle banks are non-crop habitat, Fianna found that they provided some market opportunities including harvesting the native grasses for use as filler in flower bouquets; and for inoculating the wood chips and harvesting mushrooms for market.

A downside to beetle banks is they can provide overwintering habitat for voles.

Larger path size (24") is recommended because grasses can grow quite large and encroach on production beds near beetle banks.

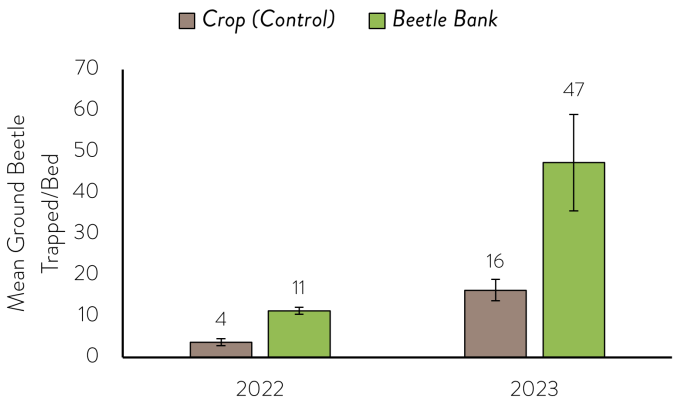
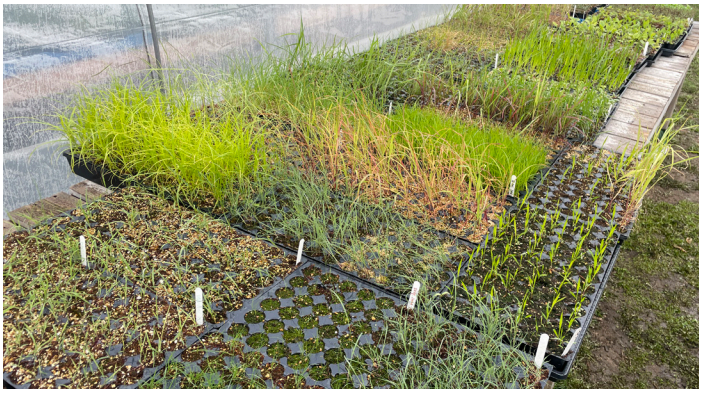


Figure 4. Mean number of ground beetles trapped in crop beds and beetle banks.

The beetle banks were first established in the fall of 2022, alongside a rye cover crop.

A big headed ground beetle (*Scarites subterraneus*) found in a beetle bank.



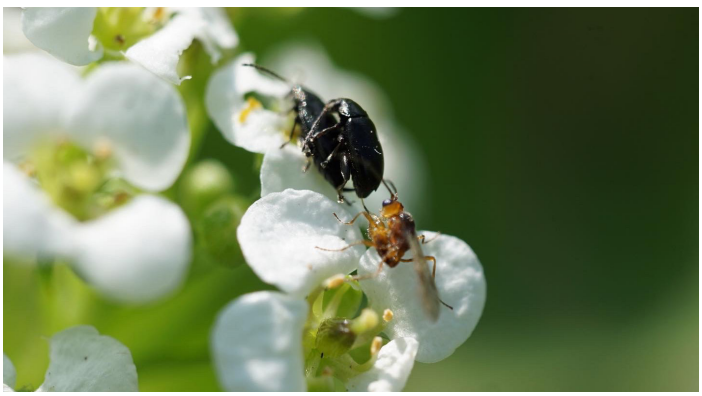
Native grass seedlings hardening off outside the greenhouse, in preparation for planting in the beetle banks. The beetle banks consisted of 70% native bunching grasses, and 30% native flowers.

Two bronze ground beetles (*Carabus nemoralis*) making a run for it. Ground beetles are hard to find and even harder to photograph!

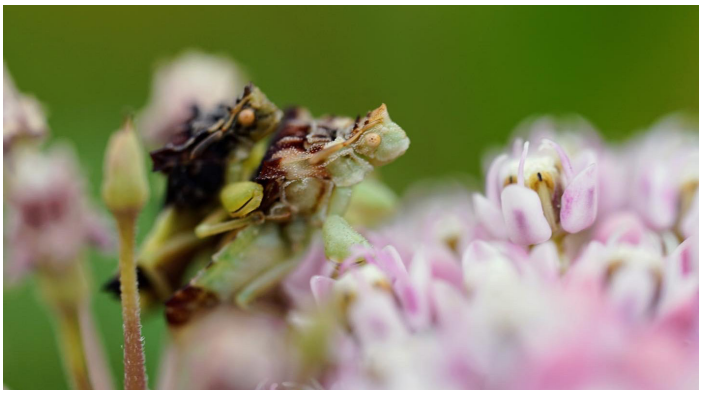
The beetle bank, one year later, in 2023.

A bold jumping spider (*Phidippus audax*) found in a beetle bank.

The same beetle bank in 2023.



A parasitoid wasp laying eggs on mating flea beetles in bed adjacent to beetle habitat.



Ambush bugs on swamp milkweed — one of the flower species making up a diverse beetle bank habitat. The beetle banks were first established in the fall of 2022, alongside a rye cover crop.

Wine cap mushroom (*Stropharia rugosoannulata*) flushes growing from inoculated wood chips used in the beetle bank. The bases of the grasses offer a shaded environment for them to grow.

A lady beetle taking flight from a yarrow flower in a beetle bank.

Another beetle bank replicate creating a nice backdrop for some garlic and kale.

TAKE HOME MESSAGE

Beetle banks can increase ground beetle populations at small scales (<20 hectares) and, in turn, possibly reduce weed and pest pressures (**3,6**).

Seeing number differences in field blocks only 76 ft away suggests that more species specific habitats in smaller farms could increase beneficial insect numbers.

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