Evaluating the impact of flower mixtures with nurse crops on beneficial insects and their ecosystem services

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Introduction

- Monoculture farming in the Canadian Prairies has led to a 60% landscape simplification since 1996 and a 70% biodiversity loss in southern Manitoba.[1] To counteract this, strategies like flower strips and nurse/cover crops are being tested to restore biodiversity and ecosystem function.
- Flower strips provide resources for pollinators and natural enemies, boosting biodiversity and enhancing diverse ecosystem services, such as pollination and pest control, thereby reducing reliance on pesticides.[2, 3]
- Little is known about how to best establish flower strips, or which flower mixtures attract effective to beneficial insects.

Objectives

- Evaluate the effectiveness of different flower mixtures with oats as a nurse crop in attracting pollinators and predators.
- Assess how different flower mixtures impact arthropod predation services by using plasticine caterpillars as sentinel prey.

Materials and Methods

- Experimental plots were established at the University of Manitoba Research Farm in Carman, Manitoba, in 2023 (Fig. 1).
- All flower mixtures were pre-mixed commercial seed blends.
- Treatments were assessed in a CRBD with 4 replicates, conducted biweekly from late July to early September (Fig. 2).

Figure 1. Experimental plots (4 x 8 m)

Figure 2. Seven treatments x 4 replicates

Figure 3. Pests and beneficial insects observed on a sunflower.

- Bee bowls were deployed in each plot for 24 hours to capture pollinators.
- Pitfall traps and clear sticky traps were set for seven days per plot to assess the abundance of ground predators, and the ratio of foliar pests to predators-parasitoids, respectively (Fig. 6).
- Seven plasticine caterpillars (15 x 3 mm, n = 588) per plot were placed next to each pitfall trap to count the number of bites by arthropod predators to assess predation (Fig. 4).
- The identity of arthropod predators was determined by comparing the bite marks on the caterpillars with the attempted bites recorded using one solar panel camera per week (Fig. 5).
- Weed dry biomass was measured at the end of the experiment.[‡]
- Flower coverage percentage was measured using photo pixel analysis.[‡]
- Dependent variables were square root transformed. Differences were tested using one-way ANOVA and Tukey's HSD for pairwise comparisons.

Figure 4. Plasticine caterpillars

Figure 5. Solar panel camera

Results

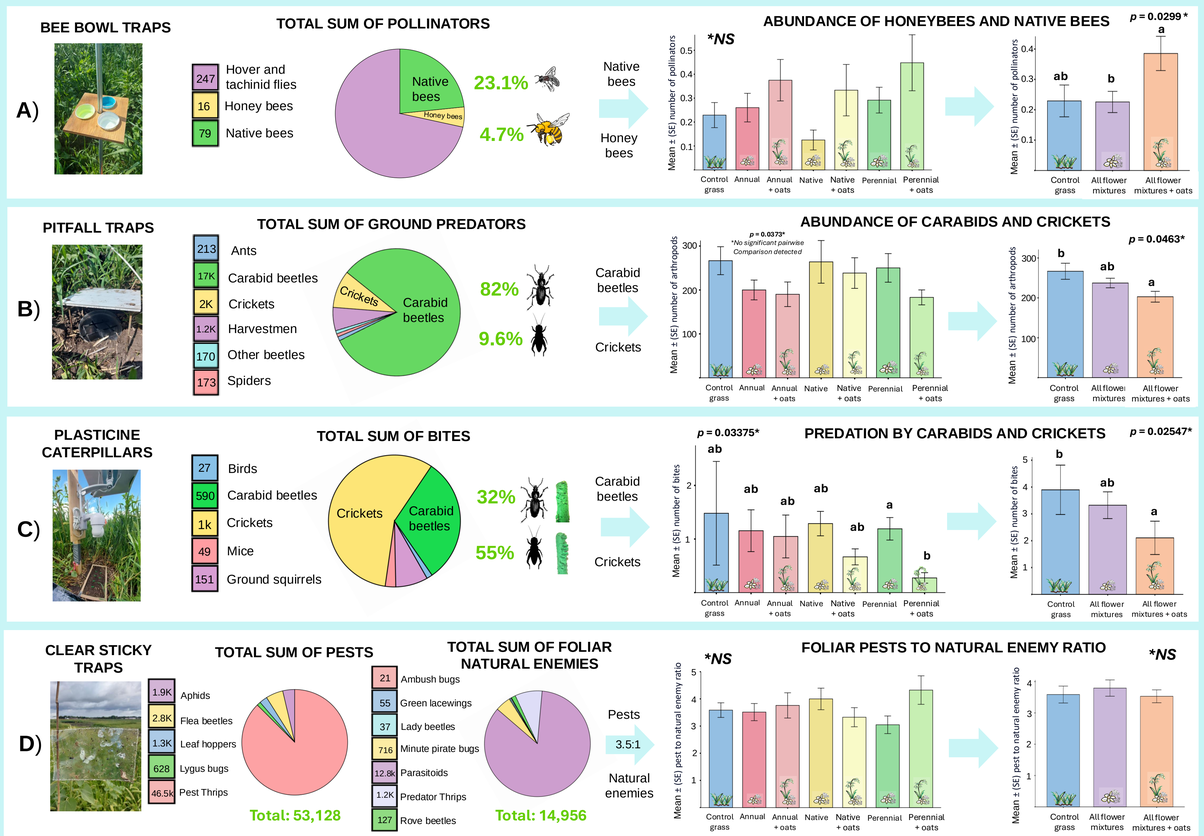

Figure 6. Total arthropod abundance by group represented as pie charts. Bar plots compare the seven treatments, while the bar plot beside groups the treatments with and without oats. **A)** Pollinators (honey bees and native bees) captured in bee bowls. **B)** Ground predators collected in pitfall traps. **C)** Predation (number of bites) on plasticine caterpillars by carabids and crickets. **D)** Ratios of pests to predators-parasitoids from clear sticky traps. Means ±1 SEM are presented. Letters denote significant differences in means (Tukey test, α = 0.05; NS = no significant differences).

Table 1. List of bees captured in bee bowls categorized by treatment. Species listed in ***bold*** were uniquely found in either oat nurse treatments or treatments without oats. *Uncommon native bee identified

Flower mixtures without oats (31)		Flower mixtures with oats (54)	
Perennial (13)		**Perennial Oats (21)**	
Agapostemon texanus	1	*Agapostemon texanus*	1
Andrena lupinorum	1	***Agapostemon virescens***	1
Apis mellifera (honey bee)	3	*Apis mellifera* (honey bee)	5
Lasioglossum leucozonium	1	***Hylaeus fedorica****	1
Lasioglossum lineatulum	1	*Lasioglossum albipenne*	1
Lasioglossum paraforbesii	2	*Lasioglossum lineatulum*	2
Lasioglossum perpunctatum	1	*Lasioglossum paraforbesii*	3
Lasioglossum pruinosum	2	*Lasioglossum perpunctatum*	4
Lasioglossum semicaeruleum	1	*Lasioglossum semicaeruleum*	1
Annual (12)		***Melissodes agilis***	2
Agapostemon texanus	2	**Annual Oats (18)**	
Halictus confusus	1	***Andrena miranda***	1
Lasioglossum albipenne	4	*Andrena thaspii*	1
Lasioglossum leucozonium	1	*Apis mellifera* (honey bee)	2
Lasioglossum paraforbesii	3	***Heriades carinata***	1
Nomada vincta	1	*Lasioglossum albipenne*	5
Native (6)		*Lasioglossum paraforbesii*	3
Andrena thaspii	1	*Lasioglossum perpunctatum*	2
Lasioglossum albipenne	2	***Lasioglossum semicaeruleum***	1
Lasioglossum paraforbesii	2	***Melissodes bimaculatus***	1
Lasioglossum perpunctatum	1	***Sphecodes cf. coronus***	1
Control grass (10)		**Native Oats (15)**	
Agapostemon texanus	1	*Apis mellifera* (honey bee)	6
Lasioglossum albipenne	1	***Bombus ternarius***	1
Lasioglossum paraforbesii	1	***Halictus rubicundus***	1
Lasioglossum lineatulum	1	***Heriades carinata***	1
Lasioglossum perpunctatum	2	*Lasioglossum lineatulum*	1
Lasioglossum zephyrus	1	*Lasioglossum paraforbesii*	1
Melissodes agilis	3	*Lasioglossum perpunctatum*	2
		Lasioglossum semicaeruleum	1
		Melissodes agilis	1

Lasioglossum spp. were the most abundant native bee followed by ***Apis mellifera.***

WEED DRY BIOMASS[‡]

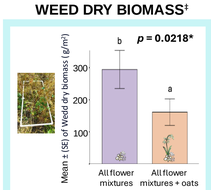

Figure 7. Weed biomass combined for flower mixtures with and without oats.

FLOWER COVERAGE %[‡]

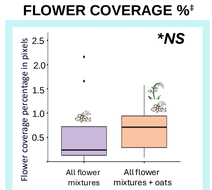

Figure 8. Flower coverage combined for treatments with and without oats.

Conclusions

- Hover and tachinid flies were the most abundant pollinators captured in bee bowls, but bees were more significantly attracted to oats nurse treatments (Fig. 6A), possibly by the slightly higher percentage of flower coverage (Fig. 8).
- Carabids were the most abundant ground predators (Fig. 6B) captured in the pitfall traps.
- Control treatment (fall rye grass) and flower mixtures without oats resulted in highest predator abundance and predation levels by carabids and crickets (Fig. 6B and 6C).
- Pest:natural enemy ratio was 3.5:1 and did not differ among the treatments (Fig. 6D).
- Oats nurse treatments reduced weed biomass (Fig. 7), possibly reducing predator abundance and resulting in fewer total bites on caterpillars (Fig. 6C).

References and Acknowledgments

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Special thanks to Adam Kozuska[‡] for providing data on weed dry biomass and flower coverage, and to Mandeep Kaur and Aleksandar Zashev for their assistance with setup and data collection in 2023. Gratitude also goes to summer students Shirley Morris and Guilherme Falsarella for processing predation video recordings to identify ground predators in 2024. Thanks to Jordan Bannerman and Shayla Woodland for their editorial assistance and support, and to Dr. Jason Gibbs for bee identification. This work was funded by the Natural Sciences and Engineering Research Council of Canada and the Leveraging Ecosystems to Transform Agriculture on the Prairies (LEAP) program.