Efficiency of Pollinators on *Echinacea angustifolia*

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Introduction

Tall grass prairie used to be the dominant habitat in the plains states and part of the Midwest. However, since European settlement, the vast majority of the native range has been destroyed and fragmented to less than 0.1% (Sampson and Knopf, 1994). *E. angustifolia,* the purple coneflower, is a model prairie plant that is often used in prairie restoration. It is self incompatible and not wind pollinated; therefore, it relies heavily on insect pollination for reproduction (Wagenius, 2004). Bees are the primary pollinators. There are over 26 native bee species that pollinate *E. angustifolia* (Wagenius and Lyon, 2010). It may not be the number of visits that *E. angustifolia* receives, rather the species of bee that is visiting which determines how well *E. angustifolia* gets pollinated. Some species of bees may be more efficient in pollinating *Echinacea* than other species based on their size and the amount of pollen they carry. When the florets of an *Echinacea* is pollinated sufficiently, the styles shrivel. However, if pollination does not occur, the styles can persist for 7- 10 days (Wist, 2005). In turn, sufficient pollination is measured by the amount of styles that shrivel. Knowing how efficient certain bees are at pollinating *E. angustifolia* will help scientists predict the future reproduction success of *E. angustifolia* based on bee populations.

Objective & Hypothesis

To determine which bee species are the most efficient at pollinating E. angustifolia and to quantify how efficient they are.

- Melissodes will be the most efficient pollinator
  - •Observed carrying large pollen loads

•Smaller bees (6 – 8mm) will be least efficient at pollinating
  - •Cannot carry large pollen loads

Methods

•Study was conducted in the common garden in Douglas County, MN
•The common garden is a 46m x 123m plot planted with *E. angustifolia* seeds originating from prairie remnants within 6mi. This was designed to have plants from each remnant in a common environment for experimental purposes.

For observing styles at the base of flowering head:
Day 1: First row of anthers out, pollinator exclusion bag on Echinacea head
Day 2: First row is now styles, second row of anthers out. Paint bracts of anthers
Day 3: Remove bag for a timed single insect visit (SIV)
Day 4: Assess persistence and shriveling of 1 and 2 day old styles

For observing styles near the top of flowering head:
Day 1: Bracts of anthers painted, and head is bagged
Day 2: Allow Second row of anthers to emerge
Day 3: SIV, and paint bracts of anthers in the third row
Day 4: Assess persistence and shriveling of 1 and 2 day old styles

Study Species

Echinacea angustifolia

Agopostemon, 11mm

Augochlorella, 7mm

Lasioglossum, 7-10mm

Melissodes, 10-15mm

Ceratina, 6-8mm

Table 1. Generalist bees observed on *E. angustifolia*

Family	Taxa
Halictidae	*Agopostemon virescens*
Halictidae	*Augochlorella striata*
Halictidae	*Lasioglossum sp.*
Anthophoridae	*Ceratina calcarata*
Anthophoridae	*Melissodes sp.*

Results

Figure 1. The total average number of styles shriveled for each pollinator species and the number or visits per species from June 29th – July 15th

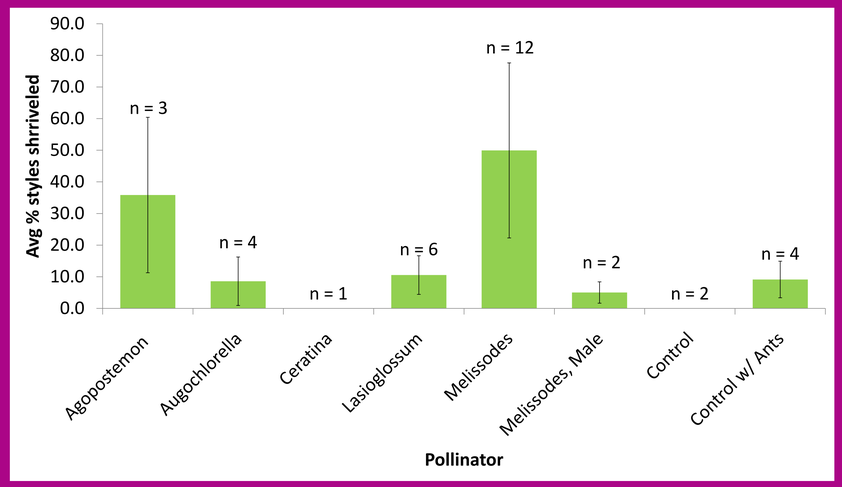

Table 2. The average time each pollinator spent collecting pollen compared to the number of 1 and 2 day old styles and total styles that shriveled (were pollinated)

Pollinator	Avg time spent (min : sec)	Avg % 1 day styles shriveled	Avg % 2 day styles shriveled	Avg Total % styles shriveled
Agopostemon	3:23.07	31.5	42.0	35.8
Augochlorella	4:52.25	3.9	13.6	8.6
Ceratina	0:39.01	0	0	0
Lasioglossum	5:18.20	0.9	19.2	10.5
Melissodes	2:15.33	41.8	58.4	49.9
Melissodes, Male	1:18.50	3.1	6.8	5.0
Control		0.0	0.0	0.0
Control w/ Ants		0.0	20.4	9.1

Results continued

Statistical Significance: (Fig 1)

•Melissodes individuals shriveled five times more styles per visit on average compared to Lasioglossum individuals (50% compared to 10%) according to a bootstrap randomization test *p = 0.0063*, (based on 100,000 resamplings).

•The difference of proportion of total styles shriveled between Melissodes and all other bees (excluding the controls and Melissodes Male) was 33%. According to a bootstrap randomization test *p= 0.0017*, (based on 100,000 resamplings)

•The difference of proportion of total styles shriveled between Melissodes (50%) and Agopostemon (36%) was not significant. *p =0.42*, (based on 100,000 resamplings).

Biological Significance: (Table 2)

•Melissodes spent on average 2 min 15 sec on *E. angustifolia* and shriveled nearly 50% of styles
•Lasioglossum spent on average 3 minutes longer than Melissodes collecting pollen on *E. angustifolia* and only shriveled on average, 10.5% of styles
• Ants seemed to shrivel on average almost as many styles as Lasioglossum, and more styles than Augochlorella

•For all species: higher proportion of 2 day old styles were shriveled compared to 1 day old styles

Discussion & Conclusion

- Observed pollinators for approx. 40 hours
- Significant difference between Melissodes and Lasioglossum as well as all other species
- No significant difference between Melissodes and Agopostemon
- 2 day old styles may be more acceptable to pollen than 1 day old styles
- Melissodes may be the most efficient pollinator
- Melissodes was only seen present during peak flowering time, when the greatest abundance of pollen is available. Melissodes may be more efficient due to the ability to collect larger amounts of pollen during peak flowering, thus pollinating *E. angustifolia.*
  - •Whether or not Melissodes is only efficient because of its presence during peak flowering time could be further researched.

References & Acknowledgments

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