

The impact of the invasive species *Coronilla varia* (crown vetch) on pollinator guild, pollen deposition to stigmas, and fruit and seed set of *Tradescantia ohiensis* (Ohio spiderwort).



Brenda Molano-Flores
Illinois Natural History Survey
Division of Biodiversity and Ecological Entomology
1816 South Oak Street
Champaign, Illinois 61820
molano@inhs.uiuc.edu
217-265-8167

Introduction

Invasive species have been identified as one of the major reasons for lower plant species diversity in natural areas due to competition for resources such as space and nutrients. However, limited information is available to determine if these invasive species are competing for pollinators with native species (Moragues and Traveset 2005; Knight et al. 2005; Larson et al 2006). Because many native plant species, both common and rare, depend on pollinators for their successful reproduction, competition with invasive species for the same pollinators could lead to a reduction in fruit and seed production.

Coronilla varia L. (Fabaceae), or crown vetch, is considered a serious management threat in natural areas because of its persistent seedbank and rapid vegetative spreading resulting in monocultures that completely cover and shade native vegetation. In this study, I wanted to determine the pollinator guild in areas with crown vetch and the impact of crown vetch on pollen deposition to stigmas of native prairie plant species. The specific questions that I ask are: 1) does pollinator guild and visitation to native prairie species vary in areas with and without crown vetch, and 2) does the amount of conspecific vs. heterospecific pollen on the stigmas of native prairie species vary between areas with and without crown vetch. Several predictions can be made: 1) if the presence of crown vetch facilitates pollination of native prairie species, then more visitations (more pollinators) and greater amounts of conspecific pollen on stigmas of native prairie species should be expected in sites with crown vetch compared to sites without crown vetch, and 2) if crown vetch competes with native prairie species for pollinators, then fewer visitations (less pollinators) and less conspecific pollen on native stigmas should be expected in sites with crown vetch compared to sites without. In addition since crown vetch is mainly pollinated by bees, it can be predicted that this group will be the most dominant component of the pollinator guild in areas with crown vetch.

To address these questions, a study was started at the Lost Mound Unit of the Upper Mississippi River National Wildlife and Fish Refuge (Lost Mound) in southwestern Jo Daviess and northwestern Carroll counties (428159 N, 908209 W, Figure 1) in the summer of 2007. Lost Mound is 13,062 acres in size and is listed as a statewide significant natural area by the Illinois Natural Areas Inventory. A total of 47 rare species occur at the site, 15 of them being rare plant species. Crown vetch is abundant in many locations at Lost Mound and forms distinct, dense, nearly monocultural patches. It is considered a threat to the native flora of the site (Sysmtad 2004) and land managers for the site are interested in control measures for this species (personal communication Dan Wenny and Randy Nyboer, Illinois Natural History Survey). Determining the impact of crown vetch on the pollinator guild and stigma pollen load of common and rare species at Lost Mound is important, as it could verify if this invasive species is promoting or limiting pollination and successful reproduction of these native species.

The specific objectives of this study were to:

- 1) Determine if the pollinator guild and visitations to native prairie species will differ between sites with and without crown vetch
- 2) Determine if the amount of conspecific vs. heterospecific pollen on the stigmas of native prairie species will differ between areas with and without crown vetch.
- 3) Determine if pollinator guild and abundance will differ between sites with and without crown vetch.

Methods

Four patches of crown vetch were selected at Lost Mound. These patches were located in areas free of other known invasive species (e.g., knapweed, sulfur cinquefoil). Because *Tradescantia ohioensis* Raf. (Commelinaceae) or Ohio spiderwort was the only plant that grew inside the crown vetch patches, it became the main study plant inside and outside the plots (see attached original proposal). *Tradescantia ohioensis* is a perennial self-incompatible species with light violet to blue-violet flowers a terminal cyme. Each flower opens early in the morning and by mid afternoon will wilt. At Lost Mound a terminal cyme of *Tradescantia ohioensis* can have up to 40+ flowers. Long-tongued bees, especially bumblebees, are considered the main pollinators for this species. However, Halictine bees and Syrphid flies also visit the flowers, and in the case of Syrphid flies, they feed on pollen.

Four *Tradescantia ohiensis* plants were tagged inside and outside the plots on June 7 to determine flower visitation for a total of 8 plants per crown vetch patch (4 inside and 4 outside; Figure 1). On June 17 and 18, 10-minute flower visitation observations were conducted per *Tradescantia ohiensis* plant. In the case of crown vetch, four 25 m² plots, two inside and two at the edge of the patch, were observed for ten minutes. Observations were conducted by the same four people simultaneously.



Figure 1. Field assistants (left photo) searching for *Tradescantia ohiensis* plants with a single inflorescence (right photo) inside and outside a crown vetch patch at the Lost Mound Unit of the Upper Mississippi River National Wildlife and Fish Refuge.

2007 Preliminary Results

Only Syrphid flies visited *Tradescantia ohiensis* and bumblebees, honey bees, and flies were observed visiting crown vetch (Table 1). In the case of crown vetch, visitation by flies was an haphazardous event (i.e., they touched the flower but no pollination was observed).

Table 1: Total number of flower visitors to flowers on June 17*: CV = crown vetch; TO = *Tradescantia ohiensis*. * Although data were collected on June 18, is not included here since it was too windy. NA = not available due to flowers not being opened.

CV Patch	TO outside	TO inside	CV inside	CV outside
1	9 flies	NA	8 flies/ 3 bees	0
2	16 flies	NA	4 flies/ 3 bees	1 fly
3	1 fly	NA	1 fly / 1 bee	0
4	2 flies	NA	5 flies/ 2 bees	0

Based on the preliminary results, it was decided that in 2008, pollinator observation would be repeated to confirm the 2007 results. In addition, the number of visits would be increased because: 1) *Tradescantia ohiensis* plants in the inside of the crown vetch patches bloom later or fail to bloom and 2) weather conditions (i.e., too much wind) limited the window for flower visitation observations. Due to the limitation confronted in 2007, the original goals of the proposal were modified to concentrate all work on *Tradescantia ohiensis* without changing the overall scope of the original proposal. The new objectives for 2008 were as follows:

- 1) Determine if the pollinator guild and visitations to *Tradescantia ohiensis* will differ inside and outside crown vetch patches vs. native areas.
- 2) Determine if *Tradescantia ohiensis* plant height, fruit set and seed set will differ inside and outside crown vetch patches vs. native areas.

2008 Accomplishments

As of July 2008, all the data were gathered at the original four sites from 2007 and an additional site, which was added to increase sample size. In addition, it was decided that adding five native areas (i.e., without invasive species) was needed to have a better understanding of pollinator behavior and fruit and seed set for *Tradescantia ohiensis*. In the case of the crown vetch patches, 10 *Tradescantia ohiensis* plants with a single inflorescence inside and outside the patch and 10 plants with a single inflorescence in natural areas were tagged for pollinator observations and reproductive output. In addition, sites were GPSed and crown vetch patch size areas and crown vetch flower densities per patch were determined. Also, 25 flowers were collected for both crown vetch and *Tradescantia ohiensis* at each site to determine stigma pollen loads. At the time of submitting this report, only the plant height data has been entered and analyzed.

2008 Preliminary Results

Significant differences were found among *Tradescantia ohiensis* plants growing inside and outside crown vetch patches and native areas (One way Anova $F = 53.635$, $df = 2$, $p < 0.001$). *Tradescantia ohiensis* plants were taller inside crown vetch patches than outside (Tukey test $p < 0.05$; Figure 2). In addition, *Tradescantia ohiensis* in native areas were smaller than plants inside and outside crown vetch patches (Tukey test $p < 0.05$; Figure 2).

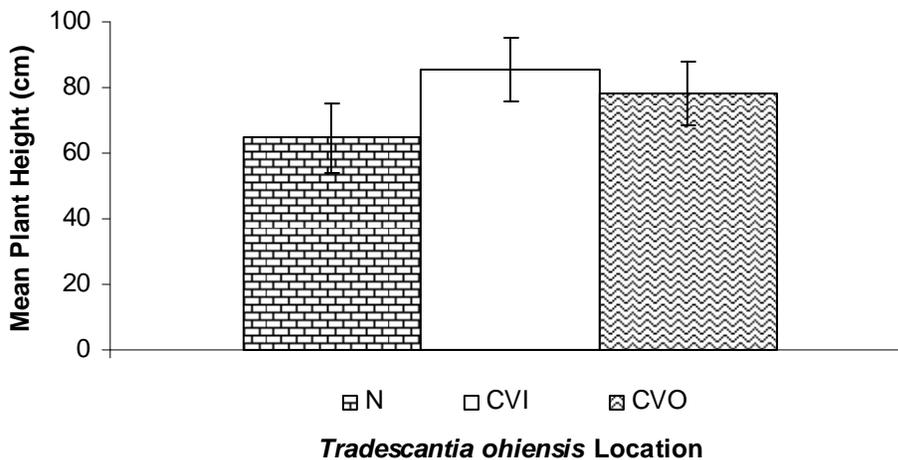


Figure 2: Mean plant height for *Tradescantia ohiensis* located in N = native areas, CVI = crown vetch – inside, and CVO = crown vetch – outside.

Future Directions

Between 2008 and 2009 pollen deposition to stigmas and fruit and seed set will be determined. Also, data analyses will be completed and results will be presented in a scientific meeting. Finally, in 2009 data will be collected again to determine if similar patterns observed in 2008 repeat again.

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