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Cropping Systems Research Summary 2019: Agroecosystems Entomology Project Research Reports

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Investigating the Role of Spiders in Integrated Pest Management for Biological Control of Nebraska Crop Pests

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Objectives

The objectives of this project are as follows:

1.) To survey and describe the spider communities within western Nebraska corn fields
2.) To determine how field management practices might impact these spider communities
3.) To elucidate the relationship of spiders with two key pests of corn: western corn rootworm (WCR) (*Diabrotica virgifera virgifera*) and western bean cutworm (WBC) (*Striacosta albicosta*)

Results

In 2017, spiders were collected from eight corn fields in western Nebraska from May 30 through August 22. Four of the fields were conventionally managed while the remaining four were managed using more conservation-based practices (such as reduced or no-till, crop rotation, and reduced pesticide use). In 2018, spiders were collected from four corn fields in Western Nebraska from May 31 through August 22. The following figures summarize the results of the project so far.

Guild	Family	2017	2018	Total	Guild %
Ambushers	Philodromidae	20	0	20	**5.8%**
	Thomisidae	32	5	37	
Foliage Runners	Oxyopidae	1	0	1	0.1%
Ground Runners	Anyphaenidae	1	0	1	**63.6%**
	Corinnidae	1	0	1	
	Eutichuridae	0	1	1	
	Gnaphosidae	30	14	44	
	Lycosidae	345	227	572	
	Trachelidae	1	1	2	
Orb Weavers	Araneidae	4	3	7	1.7%
	Tetragnathidae	3	6	9	
	Theridiosomatidae	1	0	1	
Sheet-Web Builders	Agelenidae	5	0	5	0.5%
Stalkers	Salticidae	18	1	19	1.9%
Wandering Sheet-Web Builders	Linyphiidae	196	60	256	**26.2%**
TOTALS	**15**	**658**	**318**	**976**	**7**

Figure 1: Summary of the spider families collected and the hunting guilds they represent

- Figure 1 summarizes the total number of spiders collected in 2017 and 2018 by the families they represent. Those highlighted in yellow were most abundant families.
- Each of the families were then grouped into guilds which describe the hunting/foraging methods used by the families. Those in bold were the most abundant guilds.

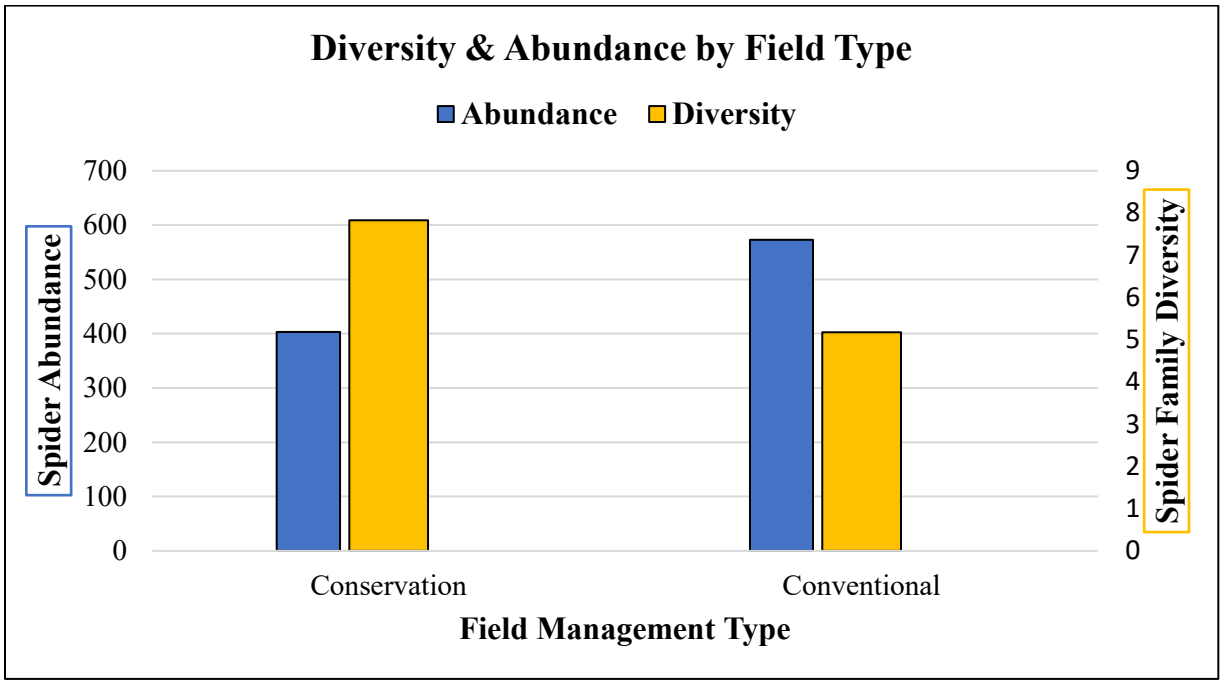

Figure 2: A comparison of the Shannon Weiner Diversity Index and Abundance of spiders between Conservation-based and Conventional fields

- Figure 2 summarizes the total number of spiders collected (abundance) and the diversity score of families represented by field management type.

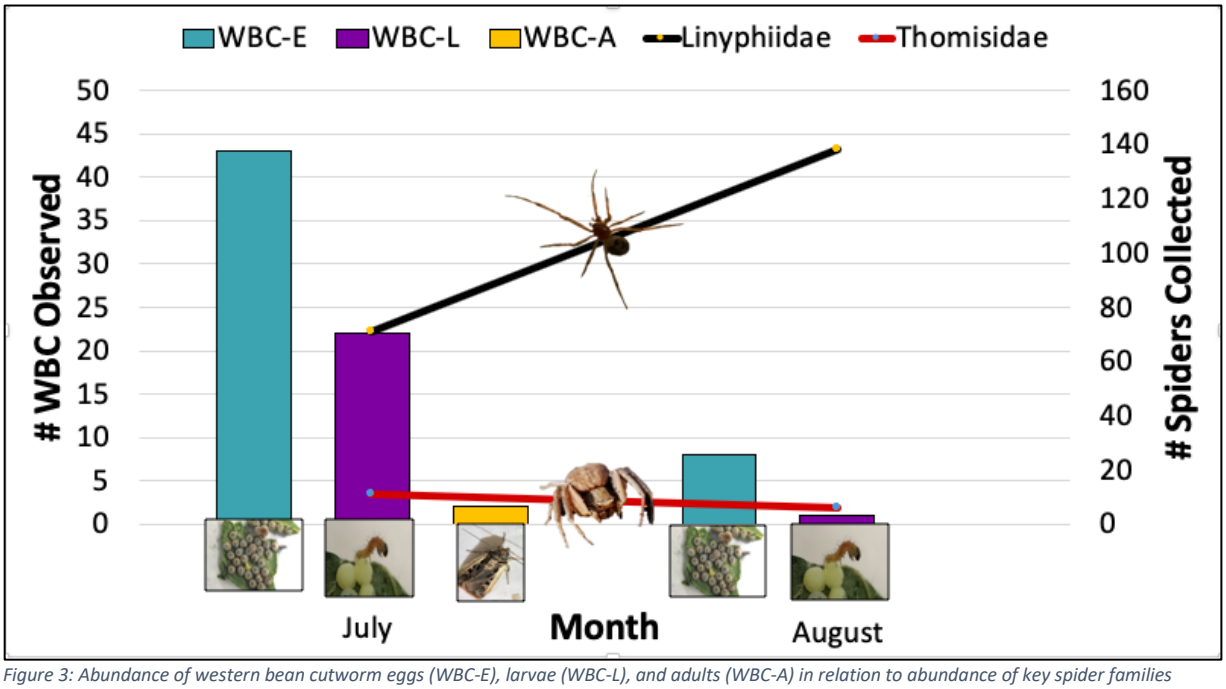

Figure 3: Abundance of western bean cutworm eggs (WBC-E), larvae (WBC-L), and adults (WBC-A) in relation to abundance of key spider families

- Figure 3 depicts the abundance of three life stages (egg, larva, adult) of western bean cutworm in relation to two spider families with the potential to interact with this pest in the field (Linyphiidae and Thomisidae).

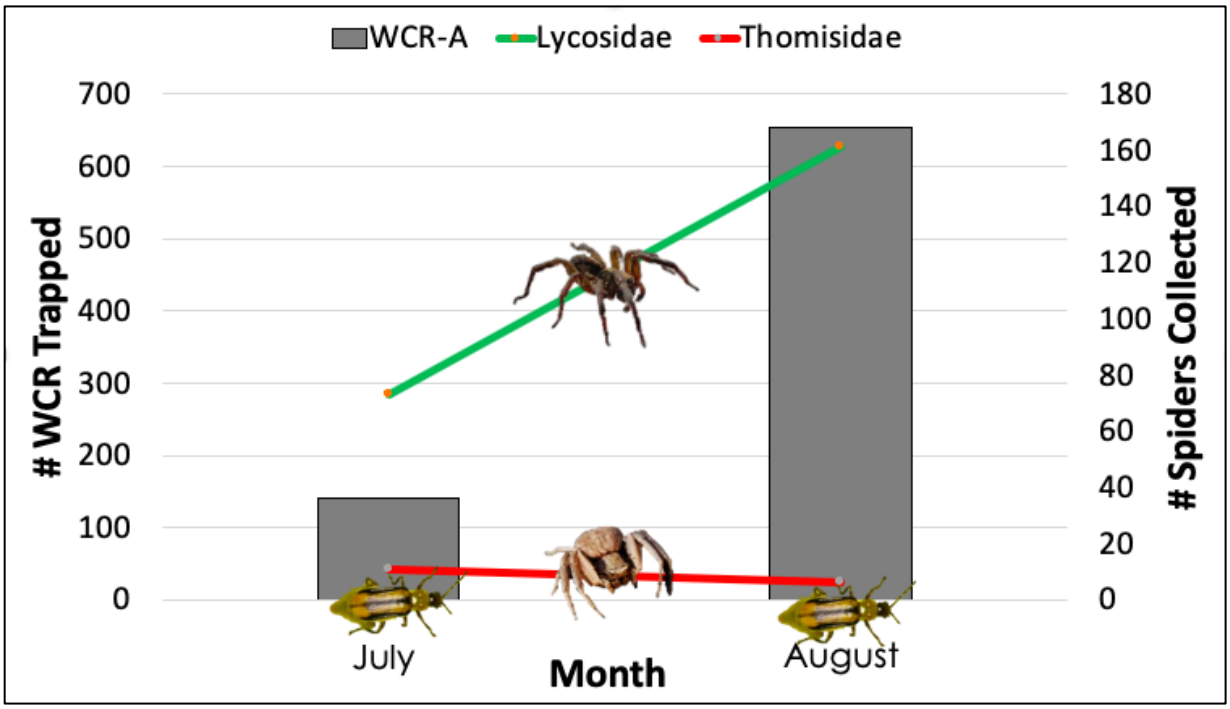

Figure 4: Abundance of western corn rootworm beetles in relation to abundance of key spider families

- Figure 4 depicts the abundance of western corn rootworm beetles in relation to two spider families with the potential to interact with this pest in the field (Lycosidae and Thomisidae).

Future Work

The next and final step of this project involve the molecular gut content analysis of spiders to reveal whether a significant trophic relationship exists between spiders and pests of corn. In addition, field management practices will be quantified in order to determine how these practices might be impacting spider communities.

The results of this project could be used to develop IPM programs and encourage field management practices that help to support spider populations within agroecosystems.

Simulating larval movement of Western bean cutworm in blended refuges by laboratory feeding on non-Bt, Cry1F and Vip3A maize

Author: Andrea Rilaković (Visiting Entomology Scholar) and Katharine Swoboda Bhattrai (Entomology Postdoctoral Associate)

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Study outline:

Western bean cutworm (WBC), *Striacosta albicosta*, is a problematic pest in corn that can cause significant yield loss. In maize, this pest can move within the same or surrounding plants. WBC have a mixed feeding habit and undergo three larval movement periods (Figure 1.). Female moths prefer to lay egg masses near the top of corn plants. After an egg mass matures and hatches, the neonates make their way up to the whorl to feed on tassel tissue (first movement period). After they have fed on pollen and tassel tissue for several days, they make their way down to the ear to feed on kernels (second movement period). At the end they have fed on ear kernels for some time, they may move to ears on other plants, to the secondary ear on the same plant, or down to the soil to pupate (third movement period).

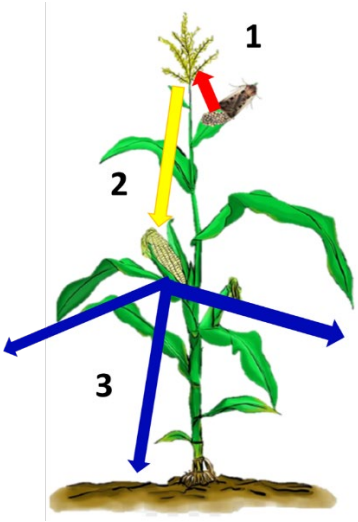


Figure 1. WBC movement in the corn plant in the field.

Experiment was conducted under laboratory conditions. Neonates (n=100) were assigned to 16 treatments based on all possible movement scenarios by switching between Bt (Cry1F or Vip3A) and non-Bt tissue during Feeding Periods #1-3. Fresh tassel (Feeding Period #1) or silks and kernels (Feeding Periods #2-3) were provided for larvae throughout the experiment (Figure 2). Observations were made every two days to verify larval survival and development. Surviving pupae were weighed and sexed.

Figure 2. Simulating larvae movement and feeding period in laboratory conditions on Bt and non-Bt corn.

Objective: The goal was to determine if there are difference in survival and performance of WBC larvae that follow different movement trajectories through a Bt cornfield that has been planted as refuge in a bag.

Results: This results will provide an important information about how larval movement in blended refuge scenarios have important implication for both insect resistance management (IRM) and integrated pest management (IPM) plans for WBC and other ear-feeding corn pests.

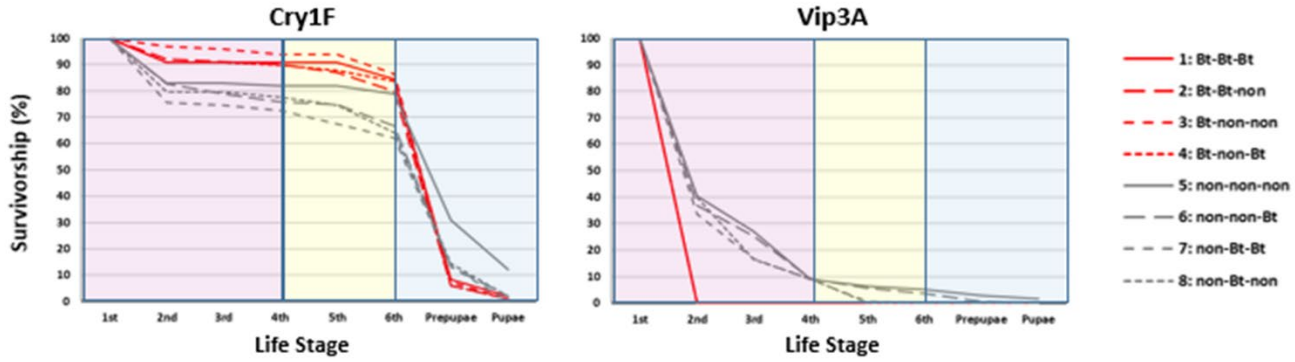


Figure 1. Survivorship of WBC life stages during three feeding periods for A) Cry1F and B) Vip3A

Surprisingly, survival was initially highest in treatments where larvae started by feeding on Cry1F tassel, but survivorship upon reaching the pupal stage was highest for larvae fed entirely on non-Bt plant tissue (Fig. 1A). This may have been due to differences between Bt and non-Bt plants (although a near isoline was used) or pollen contamination in the field.

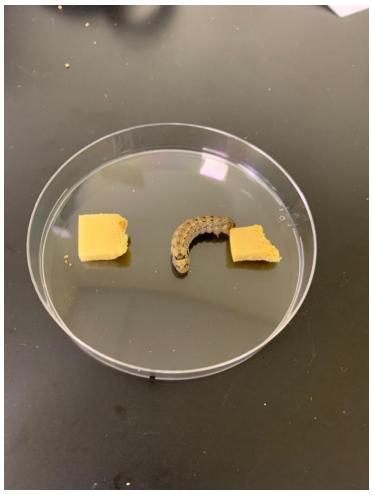
All larvae that started out on Vip3A tassel tissue died before reaching the 2nd instar (Fig 1B) Larvae that switched from non-Bt to Vip3A tissue at 4th instar died before reaching 5th instar. However, one larva that switched from non-Bt to Vip3A Bt tissue at the 6th instar survived to the prepupal stage.

Determining western bean cutworm *Striacosta albicosta* (Lepidoptera: Noctuidae) optimal nutritional intake via choice studies

Authors: Sacilotto, M. G; Battharai, K. S.; Deans, C. A.; Behmer, S.; Peterson, J. A.

The objective of this study is to determine the optimal protein:carbohydrate (p:c) ratio intake for western bean cutworm (WBC), *Striacosta albicosta,* using the geometric framework through a choice experiment. With the results, it is expected to increase the viability of this species under laboratory conditions – which has shown to be a challenge – ensuring more precise interpretations for Bt bioassays. Therefore, larvae were individually reared in Petri dishes containing one diet block, until they reach sixth instar. In this step, three diets differing in the p:c content were used. After reached the last instar, each larva was weighted and transferred into bigger Petri dishes, where they were offered two blocks of diets (with different p:c contents). The diet blocks were replaced every 2-3 days, being weighed before and after. The total consumption of each diet was measured through the difference between the weights, and a correction factor was applied considering the loss of water. When they reached the prepupal stage, the larvae were placed individually into small plastic cups with sand, where they stayed until pupal stage.

Results:




Choice_D3 (p23:c23)
Larva_68
1
5


Choice_D3 (p23:c23)
Larva_68
1
5