EXTENSION

Nebraska Wheat Stem Sawfly Program Report-2014



University of Nebraska-Lincoln
Scottsbluff, Nebraska
Panhandle Research and Extension Center

Dr. Jeff Bradshaw, Extension Entomologist
Susan Harvey, Research Technician III
Chris McCullough, UNL Graduate Student

University of Nebraska Lincoln

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Cover photos: Susan Harvey, Jeff Bradshaw, and Gary Stone

Introduction

BACKGROUND

The wheat stem sawfly (WSS) used to be an exclusive pest of spring wheat; however, in recent years changes in its seasonality have allowed it to attack winter wheat as well. It wasn't until the 1990s that this insect has posed a threat to wheat production in western Nebraska. Although it has been known to infest wheat fields primarily in Scotts Bluff, Banner, and Kimball counties, the presence of wheat stem sawfly adults was easily observed throughout the Panhandle during the 2010 Wheat Disease Survey (conducted by UNL faculty). This indicated that the WSS may be more prevalent and present a more serious risk to Nebraska than previously thought. Certain wheat production practices provide a favorable environment for this insect and may encouraging its expanding range.

RESEARCH HISTORY

In the mid-1990s, the wheat stem sawfly became a noticeable problem in the Banner and western Scotts Bluff county area. Dr. Gary Hein, UNL extension entomologist, conducted a research project (1996, 1997) to determine the effect of tillage methods on sawfly control. Some methods proved to reduce sawfly numbers; however, the following drought seasons encouraged minimal and no-till practices for water conservation. Ten years later, sawfly populations in the Panhandle were on the rise. In 2011 Dr. Jeff Bradshaw, UNL extension entomologist, conducted the first annual wheat stem sawfly survey and conducted some preliminary research on chemical control, monitoring methods, and emergence tracking. The survey sampled fields throughout the Panhandle and eastern Wyoming, and fields near Kearney, NE. Subsequent annual surveys indicate that sawflies are gaining in population density and spreading northward and eastward from their original discovery locations within the state.

RECENT ACTIVITY

In 2013, there were heavier than usual infestations in many areas of the Panhandle and untimely wind events caused severe lodging, especially in Box Butte County. This high-impact year caused more widespread concern for growers and other wheat industry constituents, prompting additional research efforts by the University of Nebraska PREC (Panhandle Research & Extension Center) and UNL, including acquiring a UNL grad student assigned specifically to wheat stem sawfly research. The insect is firmly established in the winter wheat regions of the Panhandle, Wyoming and Colorado. In 2014 the cool, wet spring and early summer conditions produced a thick stand of wheat in most places, increasing yield and reducing lodging damage; however, sawfly infestations and cutting activity remained high, a reminder to growers that the problem continues.

2014 WHEAT STEM SAWFLY PROGRAM REPORT

The University of Nebraska PREC has put together this overview of our research and extension efforts devoted to the understanding and control of the wheat stem sawfly.

2014 Research Results

1 *Wheat Stem Sawfly Biology, Behavior, and Seasonality*

1.1 Post-emergence Spatial Distribution of the Wheat Stem Sawfly

PROJECT
A study to investigate the emergence and movement of the wheat stem sawfly was conducted by UNL graduate student Chris McCullough. Objectives included determining the post-emergence dispersal pattern of the WSS in western Nebraska, determine an effective sampling technique and to correlate a relationship between emerging adults and subsequent larval infestations.

METHOD SUMMARY
Three wheat fields, bordered by WSS infested stubble from the previous year, were selected in the Nebraska Panhandle (Hemingford, Gurley, and McGrew). During the first two weeks of May 2014, fifteen emergence cages were placed in the adjacent wheat fallow of each Panhandle field location to monitor WSS emergence. Three sets of five cages were placed in a transect across the fallow field in three separate locations to assess the distribution of the previous year's infestation. These cages were checked biweekly and sawflies were counted and categorized, male or female. Sampling continued until adult sawflies ceased to emerge.

Yellow sticky cards were placed in the adjacent growing wheat to monitor the density and dispersal of emerging adult WSS. The cards were placed at the edge of the wheat, 5, 10, 20, and 30m into the field. This arrangement was repeated 14-18 times throughout a single field, varying by field. The sticky traps were collected and changed weekly. A biweekly 20-sweep (sweep net) sample was also collected at each sticky card location. All cards and sweep net samples were brought back to the laboratory for WSS counts and sex determination. Sampling began on 9 May 2014 and continued until sawflies were no longer caught. The last sampling date was 1 July 2014.

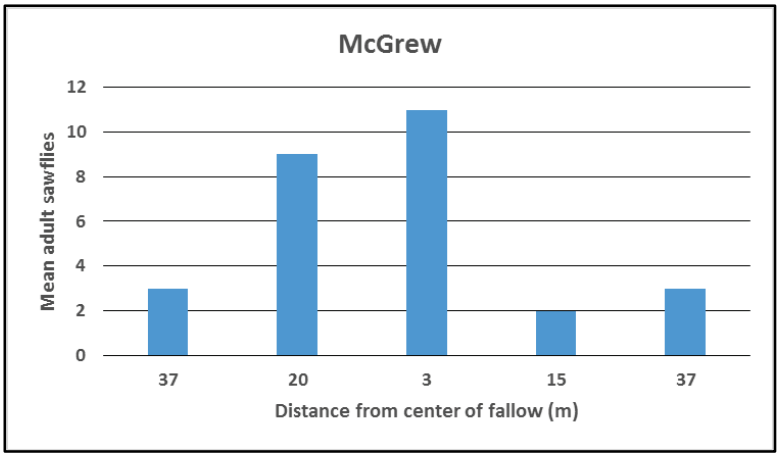
RESULTS & DISCUSSION
Three fields were selected in different regions of the Panhandle. The McGrew location consisted of narrow strips (250 ft.) of wheat/fallow in contrast to large fields at Hemingford and Gurley. Adult wheat stem sawfly emergence is often stated as occurring on the edge of a field. For this reason, planting narrow strips of wheat is not advised in heavily infested regions.
Adult emergence from cage samples did show an increased density toward field edges at the Hemingford and Gurley locations (Fig. 1). Higher sawfly numbers appeared in the cages closer to the edge of the field. This was particularly evident at the Hemingford location, where populations were highest. However, wheat may be less favorable for oviposition at the immediate edge, causing sawflies to move into the field interior.

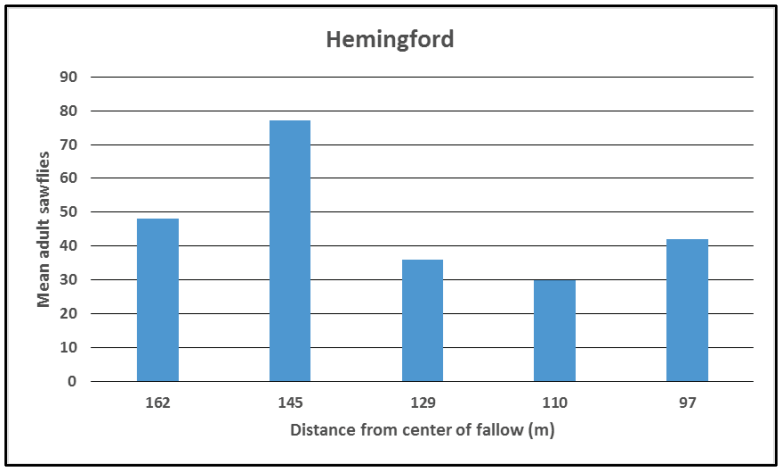
The McGrew location (Fig. 1) is an example of a narrow-field planting that resulted in higher sawfly numbers close to the center of the strip. Interestingly, field edges were spring disked by the grower before the traps were set out, which may have suppressed adult emergence. This field was also heavily infested with downy brome, especially along edges, resulting in poor wheat stands in the borders. Sawfly adults may have moved inward to find premium host plants.

Sweep net captures of adult sawflies also varied by location across the wheat field (Fig. 2). Adult activity generally was higher closer to edges, with diminishing numbers further into the field. This pattern of activity, for the most part, remained consistent throughout the flight period in all locations.

Emergence cage traps represent WSS adult activity and larval survival from the previous year. Sticky traps and sweep net captures get a representative count of current sawfly activity and may potentially forewarn the extent of future lodging problems. Trap comparisons demonstrated that more sawflies were captured with sweep nets (Table 1). Sticky cards proved to be more labor intensive and costly compared to sweep nets, especially on a per-sample basis. This study will be replicated in 2015; however, sticky cards will be omitted. Data from 2014 and 2015 will be used to fit a relationship between emergent sawflies with sweep samples.

Figure 1. Average adult sawfly per three emergence cages by distance from wheat fields near McGrew, Hemingford, and Gurley, Nebraska.





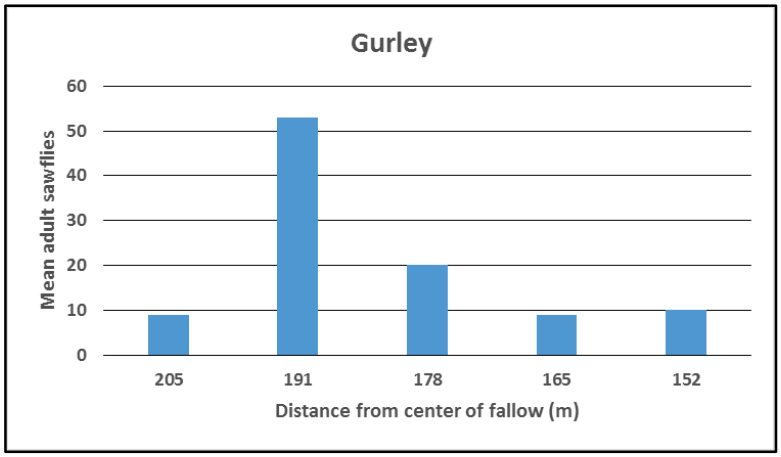
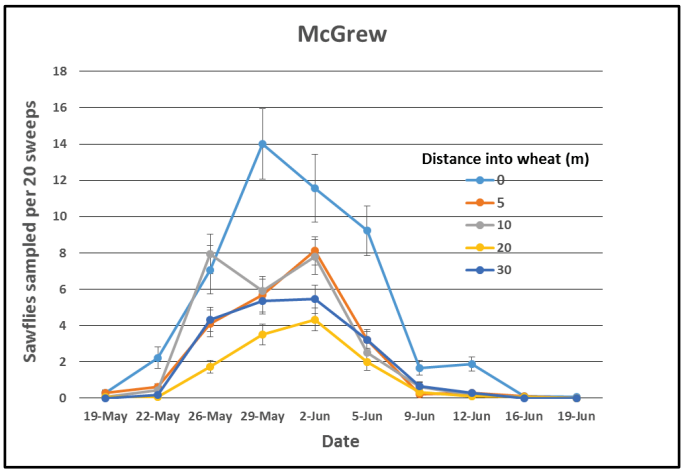
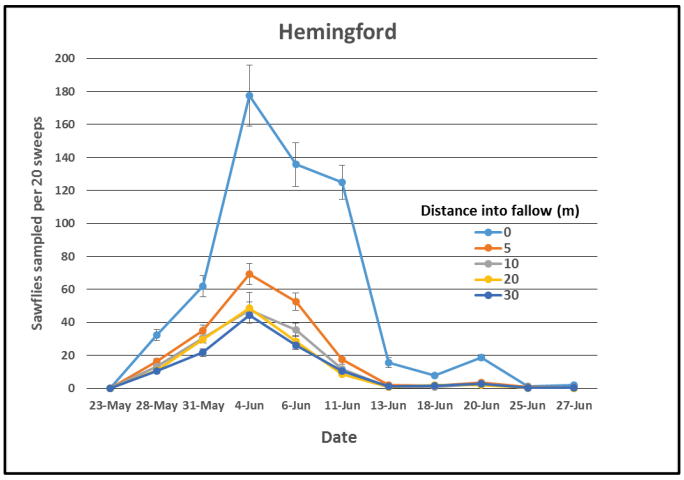


Figure 2. Average adult sawfly sweep net sample by distance from wheat fields near McGrew, Hemingford, and Gurley, Nebraska.





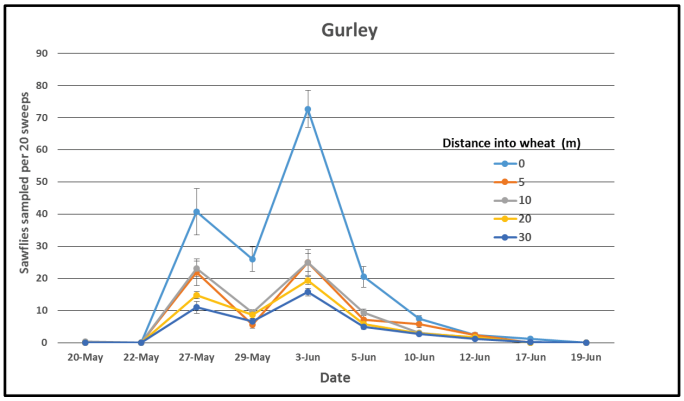


Table 1. Total number of adult sawflies captured using different sampling methods at each location during the course of the sampling period. The number in parenthesis is the number of samples taken at that location during each sampling event.

Location	Emergence cage	Sticky trap	Sweep net
McGrew	27 (15)	269 (90)	2,726 (90)
Gurley	101 (15)	652 (70)	5,680 (70)
Hemingford	245 (15)	3,902 (80)	18,505 (80)

1.2 Wheat Stem Sawfly Alternate Host Survey
Nebraska Panhandle

PROJECT
The WSS is native to North America and will infest native grasses, especially bunch grasses. The purpose of this survey was to identify and investigate the prevalence of alternate hosts for WSS in the Nebraska Panhandle.

METHOD SUMMARY
Several species of grasses were sampled from Scotts Bluff, Dawes, Banner, Cheyenne, and Morrill counties. Sources were along wheat field edges, CRP ground adjacent to wheat fields, CRP ground in absence of nearby wheat, and along ditches close to wheat fields. Grass varieties included downy brome, smooth brome, rye, intermediate wheatgrass, and Japanese brome. Stems were split and assessed for WSS presence. This preliminary data may indicate the need for future host research.

RESULTS & DISCUSSION

Table 2. Percent WSS infested stems of various grass species from select western Nebraska locations.

Grass Variety	County	Site Description	# Stems Collected	% Infested
Downey brome	Banner	Edge, infested wheat	100	43
Downey brome	Cheyenne	Edge, infested wheat	50	38
Downey brome	Dawes	Adjacent, wheat	30	0
Downey brome	Scotts Bluff	Edge, infested wheat	100	2
Intermediate wheatgrass	Scotts Bluff	CRP, near infested wheat	100	57
Japanese brome	Cheyenne	Edge, infested wheat	17	23.5
Smooth brome	Banner	Road intersection corner	15	60
Smooth brome	Banner	Edge, infested wheat	75	70.7
Smooth brome	Dawes	Edge, wheat	7	0
Smooth brome	Morrill	CRP, distant from wheat	35	14.3
Smooth brome	Scotts Bluff	CRP, near infested wheat	125	23.2
Rye	Scotts Bluff	Infested wheat field	50	4

Infested grass stems were primarily collected from areas with high sawfly numbers (Table 2). This preliminary survey indicates that WSS will inhabit alternate host grasses even with available wheat nearby. The Dawes county wheat field did not have evidence of sawfly presence. It is interesting to note that sawflies were present in CRP grass that was not located near a wheat field, indicating that populations are not necessarily restricted to wheat fields and grasses adjacent to infested wheat fields. Although unlikely, it is possible that stem sawflies collected from these grasses are another species of stem sawfly. However, there are no definitive keys to the larvae of Cephidae of North America.

This survey only shows that wheat stem sawflies oviposited in these alternate grasses and that larvae were actively feeding within the stems. It does not prove they are able to complete development and overwinter within these various grass species. However, given the fact that sawflies originated from native grasses, the need to understand the relevance of the sawfly/alternate host relationship may be an important focus for future WSS research.

2 *Wheat Variety Screening*

2.1 Selected Varieties vs Wheat Stem Sawfly, Statewide Variety Trial, Hemingford, NE

PROJECT
The UNL Variety testing program provides up-to-date information on performance of public and private winter wheat varieties across the state. Performance in terms of yield, grain quality, and disease reaction under various growing conditions is evaluated. In 2014, solid-stemmed varieties were added to the list of entries, which provided the opportunity to compare sawfly infestation rates and yield to conventional varieties under the same growing conditions.

METHOD SUMMARY
Post-harvest wheat stubble samples from eleven varieties (3 reps) were collected from the University of Nebraska Statewide Variety Trial in Box Butte County, NE. These selected varieties included hollow-stemmed varieties (Overland, Hatcher, Pronghorn, Robidoux, Goodstreak, Freeman/NE6545, Turkey, NEO9521) and solid/semisolid varieties (Warhorse, Judee, Bearpaw). One hundred and fifty stems (50 stems/rep) of each variety were split and assessed for WSS presence. The results of this field study were also compared to artificially infested wheat plants at the PREC (same varieties, excluding NEO9521).
This evaluation was also conducted in 2013.

RESULTS & DISCUSSION
Based on the results for this field study, the winter wheat variety Overland appeared to have the highest WSS larval infestation and the highest percentage of live larvae (Table 3). Conversely, the solid-stemmed variety Warhorse had the lowest infestation and percentage of live larvae. Additionally, at this location Warhorse had a statistically similar yield to the highest-yielding entries, suggesting that it may have both high WSS resistance and good yield.

Table 3. State Variety Trial WSS infestation rates and yield of select winter wheat varieties.

Variety	% infested tillers (150)	% Live Larvae	Grain Yield (bu/a)	Bushel Weight (lb/bu)
Freeman	63.3	29.3	74	59
Robidoux	67.3	36.7	72	58
Warhorse*	28.7	9.3	72	59
NEO9521	65.3	38	72	61
Overland	86.7	60.7	71	62
Bearpaw*	38.7	18.0	69	62
Hatcher	78.7	52.7	66	59
Goodstreak	58.7	36.0	66	59
Judee*	62.7	26	63	60
Pronghorn	55.3	36.7	57	61
Turkey	60.7	33.3	53	62

* These varieties are commonly referred to as “solid stemmed” varieties.

2.2 Wheat/barley Variety Trial, Cage Study, Scottsbluff, NE

PROJECT
Eleven varieties of wheat and two varieties of barley were tested against wheat stem sawfly. Hollow-stemmed wheat varieties included Hatcher, Goodstreak, Overland, Robidoux, Pronghorn, Freeman (NE6545), Kharkof, and Turkey and the solid/semisolid-stemmed varieties Bearpaw, Judee, and Warhorse. Two varieties of spring barley (Stoneham, Sidney) were also included. Barley is known to be a poor host to the wheat stem sawfly. The experiment was conducted at the PREC, Scottsbluff, NE

METHOD SUMMARY
Wheat varieties were planted into conetainers (12 cones/variety, 2 seeds/conetainer), allowed to germinate in the greenhouse, and immediately placed into the cooler (4^{o} C.) to vernalize for 7-8 weeks. Subsequently, cones were thinned to one plant and three cones/rep/variety were transplanted into 6-inch pots (44 total, 4 reps of 11 varieties). Wheat was placed in the greenhouse for continued growth.

Barley varieties were planted directly into pots (4 seeds/pot) and placed in the greenhouse. All potted plants were later thinned to one plant. Wheat stem sawfly infested stubble was collected in early spring (March) and placed in a walk-in cooler (5^{o}C) until needed. The stubble was brought out of cooler and placed in a growth chamber (23^{o}C/18^{o}C) contained in 1'x1'x1' cages until WSS adults began to emerge (approximately 18-19 days). The cages were sprayed intermittently with water for moisture during this period.

At emergence, large cages (6'x6'x3') were set up in a field area (photo), one cage/rep, over sandy loam soil. The pots of wheat were transferred to the field, placed within cages (1 pot of each variety/cage), and infested with WSS adults (stubble was placed in center of cages).
The wheat and barley were hand watered and left to grow to maturity. At senescence, plants were harvested and headed tillers were sampled for WSS infestation. This cage study, using only the wheat varieties, was also conducted in 2013.

RESULTS & DISCUSSION
Based on this study, which is largely complimentary to project 2.2, the winter wheat variety Freeman had the highest infestation, followed by Hatcher (Table 4). Hatcher had the highest percentage of live WSS larvae followed by Freeman. As in project 2.2, Warhorse produced the

fewest live WSS larvae; however, it also produced very few flowering tillers. The reduced flowering of this variety in this experiment may have influence its results. In this test, Goodstreak also showed very low WSS infestation and survival. Neither of the two spring barley varieties, Sidney and Stoneham, showed any signs of sawfly infestation. In both this project and project 2.2 stem sawflies are making choices between a number of varieties at two different special scales. However, in a field setting these choices may be quite limited. To answer this question, we would need to conduct "no-choice" tests and measure the survival of WSS under that scenario as well. We hope to conduct these more thorough studies as we make progress with project 2.4 discussed later in this report.

Table 4. Percent infested tillers and live larvae, wheat/barley cage study.

Variety	Number of tillers sampled	% infested tillers	% live larvae
Freeman	57	49.1	17.5
Robidoux	34	14.7	5.9
Warhorse*	10	10	0
Overland	61	26.2	11.5
Bearpaw*	59	23.0	8.5
Hatcher	52	34.6	26.9
Goodstreak	61	9.8	1.6
Judee*	61	6.6	4.9
Pronghorn	70	34.3	20
Turkey	50	12	8
Sidney	42	0	0
Stoneham	44	0	0

* These varieties are commonly referred to as "solid stemmed" varieties.

2.3 Evaluation and Comparison of Wheat Stem Strength of Selected Varieties in Three Regions of the Panhandle, NE

PROJECT

One of the most effective methods of WSS control in the Montana region has been the development and adaptation of solid-stemmed (additional pith tissue within the stem) wheat varieties. The reduction in sawfly damage associated with these varieties has been worth the yield drag in heavily infested regions of the northern Great Plains. The WSS escalation in Nebraska is a relatively recent problem, and therefore no solid-stemmed varieties have been developed specifically for this area. Even within the wheat regions of Nebraska, plant growth variables such as mean temperature, humidity, length of growing season, and soil type can differ vastly. Because location influences variety selection, it is important to test pith development in traditional hollow-stemmed and potential solid-stemmed varieties planted at different locations.

METHOD SUMMARY

Wheat stems were collected from three state variety trial locations, Deuel and Cheyenne counties of the southern Panhandle, and Dawes County of the northern Panhandle. The flowering tillers were split at the middle of each internode (usually 5) and given a rating of 1-5 according to the ratio of hollow space within the stem and the diameter of the stem. The internode ratings of each stem were added to assign a single number describing the solidness of the stem. This is the same rating scale that Montana is using in solid-stem ratings.

A total of seven winter wheat varieties, four hollow stem (Pronghorn, Freeman, Hatcher, Goodstreak) and three solid stem (Judee, Warhorse, and Bearpaw), were selected. Five crowns were collected from each of five reps for each variety. Three flowering tillers per crown were split and given a rating. The ratings were then compared between locations to determine differences in pith development.

RESULTS & DISCUSSION

In this experiment, wheat varieties that are commonly known as having solid stems had significantly higher pith ratings than other common Nebraska varieties at all locations (Table 5). Generally, Cheyenne County appeared to have the highest pith expression for all the tested varieties. As pith expression varies, so too does WSS resistance. We do not know if the variability recorded in the pith expression seen here would translate into difference in WSS resistance. However, if the evaluation of Goodstreak in project 2.2 (live larvae = 1.6%) does represent resistance in some fashion, then the data from this evaluation (Goodstreak ranged in pith rating from 6-8) might indicate its resistance to be unrelated to pith expression. If true, this could represent a new source of resistance to WSS. However, it would be very premature to make that conclusion based on the data from these studies alone.

Table 5. Mean stem rating (5 to 25, where 5 is hollow and 25 is solid) for seven winter wheat varieties at three locations in the Nebraska panhandle. Means followed by the same letter are not significantly different (p-val < 0.05) within each location.

Variety	Deuel	Cheyenne	Dawes
Freeman	8±0.65c	10±0.77c	7±0.67b
Warhorse*	19±1.08a	25±0.17a	18±1.31a
Judee*	17±0.93b	24±0.14a	18±0.34a
Bearpaw*	21±0.87a	23±0.42b	18±0.89a
Pronghorn	6±0.30c	8±0.74d	6±0.66b
Goodstreak	6±0.12c	8±0.59d	6±0.43b
Hatcher	7±0.29c	8±0.66d	6±0.53b

*Commonly known as "solid-stemmed" varieties.

2.4 Wheat Stem Sawfly Laboratory Colony, Establishing a Protocol UNL PREC, Scottsbluff, NE

PROJECT

The establishment of a laboratory WSS colony would be beneficial to facilitate year-round research trials on potential resistant wheat varieties, resistance mechanisms, and host preference.

METHOD SUMMARY

Stubble from the previous year's wheat crop was collected in the spring of 2014, kept in cool storage (5^{o}C), and brought out at intervals. At this point, the sawflies are in a prepupal stage. Each group of stubble was transferred to a 1'x1'x1' cage and placed in the growth chamber until the insects completed development and the adults emerged. Growth chamber temperatures were monitored and sawflies emerged in 18-20 days. Concurrently, pots of spring wheat were planted, placed in large cages in the greenhouse, and allowed to grow to the optimal stage for oviposition. Spring wheat was selected because it does not require an eight to nine week vernalization period for maturation. Upon emergence, the WSS adults were introduced to pots of spring wheat. Following plant senescence, stems from some of the pots were split to note infestation success and the remaining pots of stubble were placed in a growth chamber set at temperatures to simulate winter exposure. Wheat stem sawflies must experience a cold period in order to complete development, known as obligatory diapause. After an adequate period of time, these pots will be subsequently removed and WSS adults will be allowed to emerge, completing the first entire life cycle of artificially reared sawflies at the PREC.

RESULT & DISCUSSION

After splitting stems in six pots of wheat, infestation success proved high (75%-93%) and the majority of the larvae were alive. One of the cages consisted of a single pot with wheat plants totaling 31 stems with heads. Twenty-two of the thirty-one stems contained WSS larvae after being infested with 13 sawflies (9 males, 4 females). At this time, the remaining infested wheat stubble from these studies is still undergoing cold treatment and will soon be removed to evaluate adult emergence.

2.5 Winter Wheat Resistance to Wheat Stem Sawfly (2015 plans)

Experiments are currently underway to evaluate other potential sources of stem sawfly resistance in wheat using both conventional and transgenic approaches. More details about these studies will be shared once proper screen methods have been refined.

3 *Monitoring WSS Population Distribution and Intensity*

3.1 2014 Wheat Stem Sawfly Regional Survey, NE

PROJECT
The 2014 regional survey included 23 fields in 15 counties of Nebraska. Each county in the Panhandle was represented by at least one field, with the exception of Deuel County. The survey also included four additional Nebraska counties east of the Panhandle (Perkins, Chase, Gosper, Harlan), and Logan County, Colorado. Several unique field situations were also sampled. These included a solid stem variety, two fields border-sprayed (Mustang) specifically for WSS control, wheat next to a fallow strip that was spring plowed 14 inches deep, winter wheat that was planted in late February, wheat planted into wheat stubble, and a location with a variety under both irrigated and non-irrigated conditions.

METHOD SUMMARY
Approximately 200 stems (crowns included) were collected at each site and were brought to the PREC lab for analysis. The entomology department collected the majority of the samples; however, there were cooperators again this year who collected and mailed the wheat samples to the lab. One hundred stems were randomly selected from each location and split to assess wheat stem sawfly presence (larvae and/or frass only), plug formation, and number of live larvae. This is the fourth consecutive year of the survey.

RESULTS & DISCUSSION
Sawfly infestation rates continued to be high in 2014 in Box Butte, Scotts Bluff, Banner, Cheyenne, and Morrill county fields (Fig. 3). Garden, Dawes, Sheridan, and Logan counties had elevated numbers from previous year's data, indicating the insect is establishing well in these areas. So far, no sawflies have been detected in the eastern counties of Gosper and Harlan or in neighboring Chase and Perkins counties. Due to time and financial restraints, only one field per county was sampled in 2014. It is highly possible that sawflies may already be making their way into areas of Keith, Perkins, and Chase counties; however, at present numbers, the insects may be going unnoticed and undetected.

In 2014, several field locations that had attempted various control actions or unique conditions were also sampled and revealed the following observations. Some late-planted (Feb. 2014) winter wheat sampled in Scotts Bluff County had an infest rate of 53%. Wheat (in a heavily infested area) adjacent to wheat stubble that had been spring plowed 14 inches deep, had an infestation rate of 74%. Two growers in Box Butte County sprayed Mustang Max on field edges during adult sawfly activity, resulting in wheat that was 47% and 91% infested along those same edges. A solid-stemmed variety (Quake) planted in a heavily infested area saw an infestation rate of 35%; however, larval survival was low (14%). Most samples had very high larval survival.

Figure 3. Percent of wheat stem sawfly infested tillers by county in Nebraska and one county in Colorado in 2014. One field was sampled per county, 200 stems were collected and 100 stems randomly chosen and split.

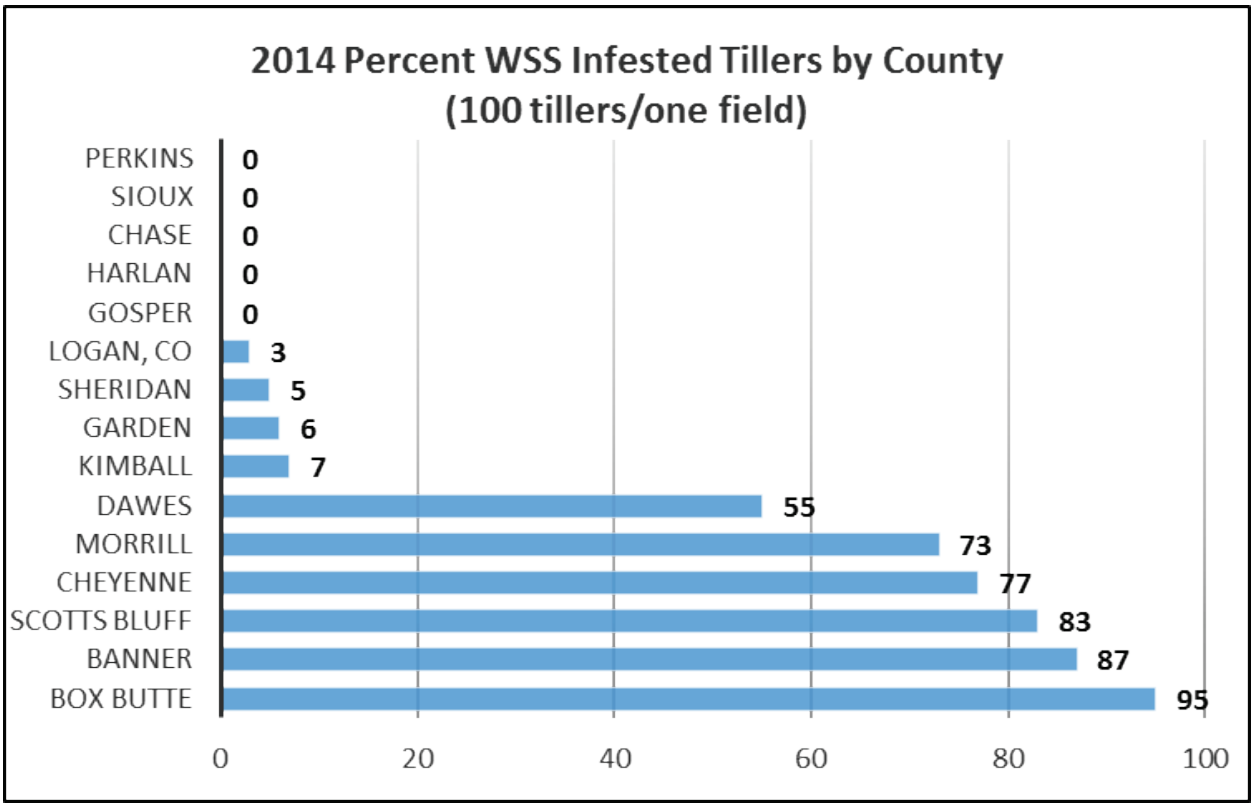


Table 6. Mean percent of stem sawfly-infested tillers out of a random subsample of 100 headed tillers of wheat. Number in parenthesis equal the number of wheat field associated with a given mean for four years (2011-2014) of the Nebraska Wheat Stem Sawfly Survey.

State	County	2011	2012	2013	2014
Colorado	Logan	--	0 (1)	1 (1)	3 (1)
	Sedgewick	--	0 (1)	0 (1)	--
Nebraska	Banner	34.9 (7)	53 (6)	52.3 (3)	87 (1)
	Box Butte	14.2 (6)	36.8 (4)	72.3 (4)	95 (1)
	Chase	--	--	--	0 (1)
	Cheyenne	11 (4)	49 (1)	62 (1)	77 (1)
	Dawes	--	30 (1)	30 (1)	55 (1)
	Deuel	--	0 (1)	--	--
	Franklin	0 (2)	0 (2)	0 (1)	--
	Garden	1 (1)	1 (1)	0 (1)	6 (1)
	Gosper	0 (2)	0 (2)	0 (2)	0 (2)
	Harlan	--	--	--	0 (1)
	Kearney	--	--	0 (1)	--
	Kimball	--	--	--	7 (1)
	Morrill	20.5 (2)	27 (2)	88.5 (2)	73 (1)
	Perkins	--	--	--	0 (1)
	Scotts Bluff	--	58 (3)	55.8 (4)	83 (1)
	Sheridan	0 (2)	0.7 (3)	10.5 (2)	5 (1)
	Sioux	--	2 (1)	--	0 (1)
Wyoming	Laramie	32.5 (2)	47.5 (2)	84 (2)	--

3.2 myFields.info (formerly iWheat.org)

The University of Nebraska-Lincoln has been an active participant of the myFields.org (formerly known as iWheat) project, a multi-state management program for winter wheat. Other collaborators include Kansas State University, Oklahoma State University, Colorado State University, Texas A&M Agrilife, and USDA-ARS. A primary objective of this project is to streamline access to science-based management resources for wheat by housing them under one website (myFields) to alleviate the need for producers to sort through the plethora of wheat management information online. Modules such as the arthropod diagnostic key, pest sampler, proposed mapping features, variety support system, and dynamic field history can be accessed by registered users. The site serves as a free, mobile-device friendly, decision-support system for wheat stakeholders. The wheat stem sawfly scouting tool is now available (http://myfields.info/pest_sampler) along with a simplified sampling scouting plan (http://myfields.info/method/wheat-stem-sawfly). Additional and more actionable recommendations will be added to this tool as research results allow. The PREC entomology department will be actively involved again with this project in 2015.

4 *Wheat Stem Sawfly Control*

4.1 Tillage Comparison Study (2015 plan)

PROJECT:
Dr. Gary Hein made some attempts at investigating the effect of tillage on sawfly control in 1995-1997. Two of the three years of his study were challenged by weather; however, one year of the study did indicate that some level of tillage may suppress sawfly emergence. The need to conserve soil moisture generally has made tillage an unattractive management option. However, because high-yielding resistant varieties and chemical options are not yet available, growers need some tools now. Therefore, the potential role of tillage in sawfly suppression will be revisited. Prior to the use of glyphosate for chemical fallow management in wheat-fallow systems, growers would commonly use a tillage operation around the border of fallow fields, primarily for weed suppression. It may be that the reduction of this practice in Nebraska has partially contributed to our current increase in sawfly populations. The data presented in project 1.1 as well as the larval data from Nansen et al. (2005) indicates that as much as 80% of the sawfly infestation occurs within the first ~15 feet of a wheat field. This might be particularly true for fields that have experienced a relatively recent stem sawfly establishment. These data suggest that it may be possible to apply a precision tillage application in the border of a fallow field to disrupt the sawfly overwintering habit and thus reduce wheat stem sawfly abundance.

METHOD SUMMARY
Field studies in 2015 will evaluate a minimal tillage approach of either once over or twice over with a disc tillage implement, as compared to no tillage, in early May 2015. This trial will be tested in two locations. Plots will be evaluated for larval survival and yield in adjacent wheat plots. Soil-dwelling arthropods will also be sampled to evaluate any negative impact the treatments have on beneficial arthropods. Specific methods and results from this study will be shared in the 2015 *Nebraska Wheat Stem Sawfly Program Report.*

LITERATURE CITED
Nansen, C., D. K. Weaver, S. E. Sing, J. B. Runyon, W. L. Morrill, M. J. Grieshop, C. L. Shannon, M. L. Johnson, and others. **2005**. Within-field spatial distribution of *Cephus cinctus* (Hymenoptera: Cephidae) larvae in Montana wheat fields. *Canadian Entomologist*. 137: 202–214.

4.2 New Chemistries – Prevethon vs Wheat Stem Sawfly (2015 plan) UNL PREC, Scottsbluff, NE

PROJECT

Insecticides are typically not a recommended management tool for the wheat stem sawfly. Contact sprays are ineffective because feeding larvae are protected within the stem. Adult sawflies emerge over a period of weeks, differing year to year due to weather dependent factors, and it is very difficult to predict when the peak adult emergence event will occur. Growers have tried rescue applications with very little success.

Prevethon (DuPont) is diamide insecticide with some systemic activity through foliar applications. It works primarily through the pest ingesting the product and has shown residual activity in a number of systems. This may work well for wheat stem sawfly control. The purpose of this study is to determine if Prevethon can kill WSS larvae in the stem when applied at or near the first emergence of adults.

METHOD SUMMARY

Field studies in 2015 will evaluate two rates of Prevethon (DuPont) on small field plots at one field location in approximately mid-May 2015. Plots will be evaluated for larval survival and yield. Specific methods and results from this study will be shared in the 2015 *Nebraska Wheat Stem Sawfly Program Report.*

Education and Extension Activities

Dr. Jeff Bradshaw and his entomology team (graduate students and technical support) were very active with meetings, clinics, conventions and other educational and extension events in the year 2014. The wheat stem sawfly was a major focus.

The 6th Annual International Wheat Stem Sawfly Convention was held in Bozeman, MT, on April 3-4, 2014. The latest WSS research from the U.S and Canada was presented and discussed by top researchers from universities, government agencies and industry. Areas of research included resistant cultivar selection, economic threshold, biocontrol, genetic applications, and management strategies. Members of the ENT team also attended a Colorado State University WSS field day (May 30, 2014) and met (April 15, 2014) with the entomology department at CSU to discuss research and collaboration strategies.

Wheat stem sawfly presentations by Dr. Bradshaw were given at the January (2014, 2015) Crop Production Clinics (Gering and North Platte, NE), 6th Annual International Wheat Stem Sawfly Convention, High Plains AG Lab annual field day (June 19, 2014), High Plains Ag lab winter annual meeting (2014, 2015), Cullan Seed Appreciation Days (August 13, 2014) and the Panhandle No-till Conference (February 9-10, 2015).

A Wheat Production Workshop, organized by UNL graduate student Justin McMechan, was hosted by the UNL PREC on August 4, 2014. Researchers from Scottsbluff and Lincoln discussed various wheat issues such as breeding virus resistant wheat, the wheat-mite-virus complex, cover crops, kochia resistance and the wheat stem sawfly. Attendees were able to receive the latest information through discussion and hands-on activities.

A poster titled, "*Review of the wheat stem sawfly*" was presented by graduate student Chris McCullough at the annual Entomological Society of America North Branch meeting (Des Moines, IA, March 9-12, 2014). Chris also gave an oral presentation at the Annual ESA National meeting in Portland, OR, (November 15-19) titled, "*Dispersal of the wheat stem sawfly*".

An extension publication titled "Wheat Stem Sawfly Information Sheet", a collaborative effort by Jeff Bradshaw, Gary Stone, Karen DeBoer, John Thomas, and Susan Harvey, was completed January 2015.

Continuing efforts are made to secure funding for WSS research projects, such as the large multi-state USDA proposal that was submitted and unfortunately turned down; but will be resubmitted in the future. As long as the sawfly continues to be problematic in Nebraska, UNL will continue to work toward finding solutions.

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