

Colorado Wheat Stem Sawfly Survey

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The wheat stem sawfly (WSS), *Cephus cinctus* Norton, has been a pest of growing concern in Eastern Colorado since it was found in wheat fields in 2010 near New Raymer, Colorado. Adult sawflies emerge from wheat stubble in spring while the crop is jointing and lay eggs over their flight period, which lasts 4 to 6 weeks. The eggs hatch and develop into larvae that chew the interior pith of the growing wheat stems. As the crop matures and dries, the larvae create a chamber near the root crown and cut the stems, causing lodging before the crop is harvested. Grain yield losses from wheat stem sawfly damage in Colorado are estimated to be \$31-33 million in 2020-2021 and \$41 million in 2022.

A statewide survey of wheat stem sawfly infestation has been conducted since 2013 by Colorado State University entomologists to determine the scope of infestations across the state. Changes to the pests range are also monitored. Approximately 100 sites are surveyed each year after the adult sawflies have completed their flight, with the number of sites collected from each county being proportional to the amount of wheat grown in the county. Collection sites are wheat fields directly adjacent to the previous year's wheat stubble, and collection sites are a minimum of 10 miles apart. For each site surveyed, 100 tillers are collected and dissected to check for the presence of wheat stem sawfly larvae. The percentage of infested tillers is reported for each sample location, with low infestation being less than 10% of total tillers having WSS infestation, medium having between 10% and 50% infestation, and high infestation being any site with more than 50% of tillers infested.

Throughout the study the total number of infested sites has increased over the years (Table 1). The number of sites with medium (10%-50%) and high infestation (>50%) levels has also grown over this period. After a drop in infested sites during 2021, the number of sites with sawfly infestation rebounded in 2022. Of note, the number of sites with severe infestation significantly increased, from three sites to 21 sites.

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Not Infested	56	50	32	81	42	46	41	33	44	34
<10%	20	30	48	11	36	26	29	41	33	15
10-50%	13	15	16	4	13	12	22	20	20	24
>50%	5	5	3	3	5	12	14	11	3	21
Total Sites	94	100	99	99	96	96	106	105	100	94

Table 1: Number of Colorado wheat fields in each infestation category using WSS larval infestations from 2013-2022.

The habitat range of the wheat stem sawfly has increased as well. In 2013, WSS was not detected in Kiowa, Prowers, or Baca counties. In several of the following years, WSS was then detected in all sampled counties. Severe drought conditions in 2022 made many of the survey sites in southeastern Colorado unusable for data collection due to lack of wheat plants, possibly contributing to the current absence of observed sawfly activity in that region.

Full survey results for 2013-2020 can be found at: <https://doi.org/10.1093/jee/toab015>.

Additional results for 2021-2022 can be found at: www.csuwheatentomology.com.

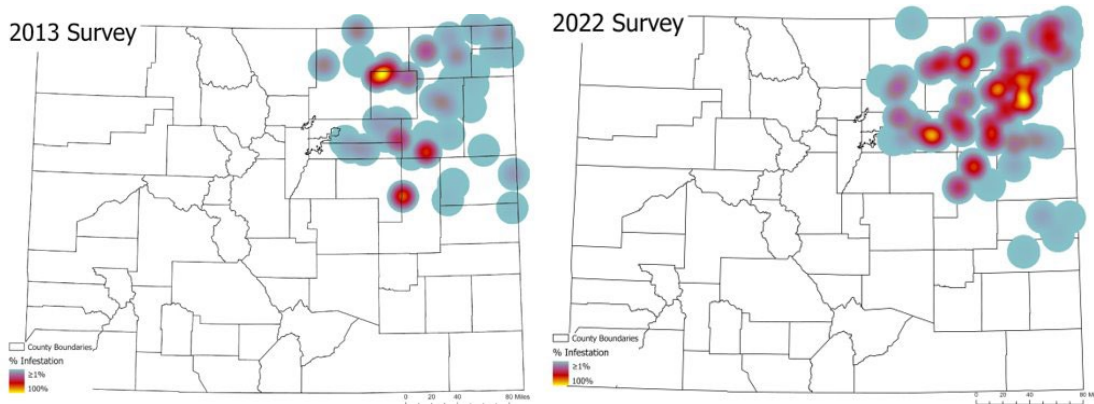


Figure 1: Percentage infestation of wheat fields sampled in 2013 and 2022 for wheat stem sawfly larvae.

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Wheat Stem Sawfly in Colorado – Frequently Asked Questions

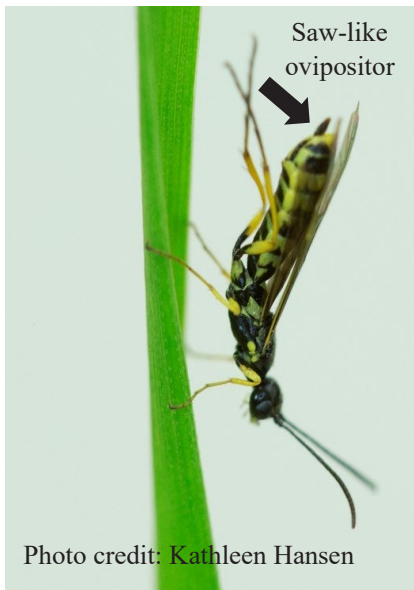
Dr. Punya Nachappa and Adam Osterholzer

Q: What type of insect is the wheat stem sawfly?

A: Wheat stem sawflies (WSS) aren't flies but wasps! They belong to a group of insects called Hymenoptera, alongside ants, bees, and other wasps. Wheat stem sawflies cannot sting. The name "sawfly" comes from the saw-like appearance of the ovipositor, which the females use to cut into plants and lay their eggs. Males lack this trait.

Q: How do I know if I have wheat stem sawflies in my field? What do they look like?

A: Starting in early to mid-May, look for small yellow and black wasps (7-12mm) on wheat plants along the edges of your field. Resting sawflies will sit on the stem facing the ground. There are other insects that are similar in appearance, but they typically won't exhibit this resting posture or be abundant in field edges. In mid to late-June, stems can be cut open to look for their white, S-shaped larvae. Compacted sawdust-like material called "frass", which collects in stems as a result of WSS feeding, is also an indication of sawfly infestation.



Adult female wheat stem sawfly sitting facing the ground (left). Wheat stem sawfly larvae in stub (right).

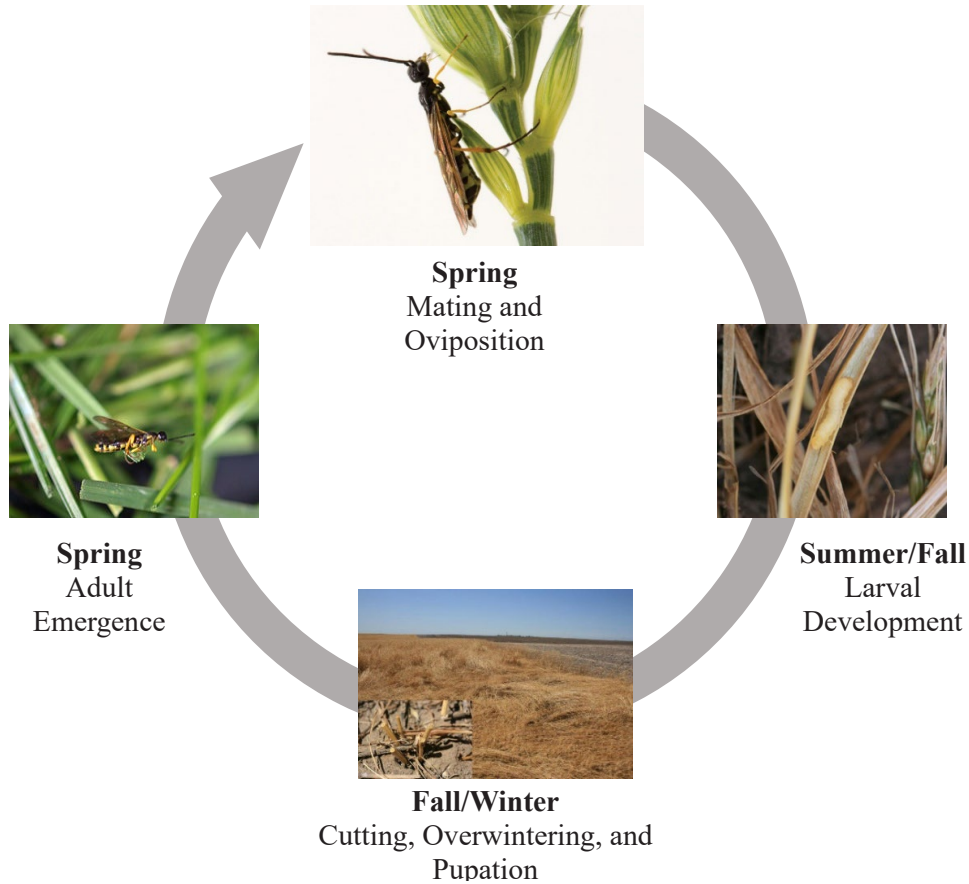
Q: What does wheat stem sawfly damage look like?

A: Before your wheat crop dries, you can cut open stems and find larvae, as well as sawdust-like frass from their feeding. Nutrients and tissue are being stolen from the plant by the larvae, decreasing crop yield. When the larvae finish feeding, they then cut the insides of the stems horizontally near the soil, making the stems prone to lodging. Lodging is especially common during strong winds and precipitation events. Unlike stems lodged from other causes, sawfly-cut stems are no longer connected to the plant.

Q: What is the life cycle of the wheat stem sawfly?

A: Wheat stem sawflies have a single generation per year. Adult wheat stem sawflies emerge from the previous year's stubble from May to June. Females lay their eggs inside wheat stems.

Although several eggs may be laid within a stem, only a single larva survives to maturity. As the plant matures, the larva moves down to the base of the stem and chews a notch around the inside of the stem. The notch usually causes the stem to break, producing a small stub that remains anchored in the ground. This stub is then filled with frass, which creates a protective chamber where the larva overwinters and undergoes pupation. The new adult either chews through the frass plug or the side of the wheat stub in the spring to start the cycle again.



Life cycle of wheat stem sawfly. Photo credits: Bugwood.wiki, Kelsey Dawson

Q: How do weather patterns impact sawfly movement and would severe cold temperatures kill off larvae?

A: Dry weather favors wheat stem sawflies. Excessively wet conditions tend to be detrimental to both sawfly and parasitic wasp populations. Severe cold as seen during the winter storm of 2020 typically does not affect wheat stem sawfly populations, as they are known to tolerate much colder temperatures in Canada. We are currently studying how weather trends impact the emergence timelines of adult sawflies.

Q: Do we find wheat stem sawfly in all wheat-producing counties?

A: Yes, as of 2020 wheat stem sawfly has been found in wheat in all wheat-producing counties in eastern Colorado. Most damaging infestations have been found in north central Colorado, with a few lighter infestations occurring as far south as Baca County. Drought conditions limited our use of southeastern survey sites in 2022. We hope to gain a more comprehensive understanding of the situation in this region in 2023.

Q: Where are the wheat stem sawflies coming from?

A: The wheat stem sawfly is native to Colorado and was first discovered in 1872 on non-cultivated grasses. Many believe that the insect adapted to wheat as European settlers began large-scale cultivation of cereal crops. It has long been a threat to spring wheat production in the Northern Plains and has become a significant pest of winter wheat as well.

Q: Why are we starting to have wheat stem sawfly problems now?

A: There is no good answer to this question, but it likely is due to some combination of the changes in the wheat stem sawfly's preference for wheat, changes in production practices (e.g., reduced tillage), and changes in climate.

Q: What is the estimated crop loss due to wheat stem sawfly in Colorado?

A: The annual economic loss in Colorado is conservatively estimated at \$31-\$33 million.

Q: How fast can wheat stem sawflies spread?

A: According to CSU survey results, damage in wheat was mostly limited to the New Raymer area in 2012. By 2020, wheat stem sawfly was found in all eastern Colorado wheat-producing counties. Heavily damaging populations can be found as far south as I-70, with most hotspots centering in the northern part of the state.

Q: Can we predict/react to wheat stem sawfly infestations ahead of time?

A: According to Canadian guidelines, observing greater than 10-15% sawfly cutting in wheat stems from the previous year indicates that adjacent fields should be planted with something other than wheat. If wheat is planted, resistant commercial varieties should be utilized.

Q: What are the hosts of wheat stem sawfly?

A: The cultivated hosts of wheat stem sawfly are limited to cereal grains with similar life cycles to wheat (winter/spring wheat, triticale, barley, rye). Wheat stem sawfly is not known to survive on oats or flax. The list of native and non-native grass hosts of the wheat stem sawfly is extensive and includes bromegrasses, wheatgrasses, wild ryes, and many other species commonly found in the state.

Q: What rotation crops can reduce the level of wheat stem sawfly infestation?

A: None of the common rotational crops (corn, proso millet, sorghum, sunflower) are affected by wheat stem sawfly. It is very important to plan rotations to avoid planting new wheat immediately adjacent to stubble infested during the previous crop. Crop rotation also has disease and pest management implications, and soil fertility benefits.

Q: How long do I have to stay out of wheat to reduce the problem, so I can go back to wheat with minimal loss of yield?

A: Wheat stem sawflies infest wheat fields in May and June and will remain in the field until adults emerge the following spring. At that time, adult sawflies disperse from the field looking for new wheat to infest, so the field could be planted with wheat that fall without risk of infestation by the sawflies of the previous year. However, sawflies from adjacent fields or greater distances may infest the new crop, and sawflies can still survive in nearby native grasses.

Q: How effective is tillage in controlling the wheat stem sawfly?

A: Both fall and spring tillage have been used to expose crowns containing overwintering larvae to moisture and temperature extremes, but it has not been particularly effective. Also, tillage will negatively impact the natural enemies that also overwinter in the stubs. If tillage is utilized, it is a tool best reserved for use in fields with low-to-moderate infestation.

Q: Are there wheat varieties that are resistant to wheat stem sawfly?

A: Yes, there are sawfly-resistant varieties that have a trait called “solid stem”. In these plants, the center of the stems is filled up entirely with tissue, making it difficult for eggs to be laid inside it. Solid stem varieties of wheat have also shown to be effective in impeding larval development and movement, thus reducing larval survival. CSU has released a semi-solid variety, Fortify SF, a medium maturity variety with wheat curl mite resistance and a similar yield potential to Byrd under normal field conditions. It is not highly resistant to sawflies because it has only a semi-solid stem. However, it is substantially more resistant than other locally adapted varieties. Breeding wheat varieties for WSS resistance remains a high priority for CSU.

Q: What is known about the consistency of expression of stem solidness, and the degree of resistance conferred by the new semi-solid varieties?

A: Reports from Montana and Canada suggest that certain environmental conditions, such as lower light intensity from increased cloud cover or lower elevation, may result in reduced expression of solidness. We do not yet know for certain how much of an issue this will be here in Colorado with our higher light intensities. The level of expression of semi-solidness observed has provided significant reductions in stem cutting during field trials.

Q: Is there a yield drag associated with the new semi-solid varieties?

A: There is a yield drag, based on our CSU Elite trials. When comparing the semi-solid plants to non-resistant varieties, we estimated the yield drag to be about 4.5% in the absence of wheat stem sawfly. Semi-solid varieties should outyield susceptible varieties if both are infested with sawflies.

Q: Does the wheat stem sawfly have any natural enemies?

A: There are a few insect species that feed on the wheat stem sawfly. The most important of these are two parasitic wasps, *Bracon cephi* and *Bracon lissogaster*, whose larvae can be found feeding on wheat stem sawfly inside wheat stems.



Comparison of wheat stem sawfly and its parasitoids.

Q: How important are these parasitic wasps in Colorado?

A: To date, in Colorado few specimens of either wasp species have been found feeding on wheat stem sawfly in wheat. They are more easily found on wheat stem sawfly larvae infesting non-cultivated grasses. The parasitic wasps are considered to be important management tools in the Northern Plains, which have a longer history of wheat stem sawfly infestations in wheat.

Q: Are there practices that will encourage the parasitic wasps to attack wheat stem sawfly?

A: These parasitic wasps are expected to become more important as they adapt to wheat stem sawfly infestations in wheat. Tillage and swathing fields are two practices known to affect them negatively. However, if provided with sugar resources, such as flowers, adult parasitoid wasps can live longer and produce more offspring. Research has shown that incorporating buckwheat into cover crop mixes could enhance parasitoid performance.

Q: How can I control existing wheat stem sawfly infestations in my wheat?

A: Little can be done to eradicate the sawflies once your wheat is infested. No effective chemical controls are currently available. Stem cutting can be reduced by swathing, and stripper headers are better at picking up cut stems than traditional headers. Planting resistant varieties of wheat and using proper crop rotations can further mitigate losses.

Q: Can wheat stem sawflies be controlled with insecticides?

A: The egg, larval, and pupal stages are found within the stem, making them inaccessible to most insecticides. To date, no insecticides have been found to be very cost-effective at controlling wheat stem sawfly. More research into the topic is currently underway. Of note, it is suspected that the exact timing of pesticide applications will dramatically impact their effectiveness.

Q: Will swathing my wheat reduce losses to wheat stem sawflies?

A: Wheat can be swathed before stem cutting starts. Disadvantages to swathing include the cost of an extra field operation and negative effects on the parasitic wasps that are feeding on sawfly larvae. Costs can be reduced by swathing just the field margins, where infestations generally are more severe. Effects on natural enemies of the sawflies can be minimized by leaving the lower third of the stem intact.

Q: What is the best way to recover cut stems during harvest?

A: Combines equipped with stripper headers are the most efficient means of retrieving cut stems at harvest.

Q: Can the wheat stem sawfly be eradicated?

A: No. To date, we have no appropriate management methods that can eliminate this insect from fields. Further, this insect is native to Colorado and is well-adapted to our environment. Finally, you would need to eradicate them from all non-cultivated grasses as well as from wheat, since they can reside in either type of host.

Q: How do I prevent wheat stem sawfly infestations in my wheat?

A: Current preventive measures include planting semi-solid varieties, reducing the amount of wheat in your rotations, avoiding planting new wheat plants next to wheat stubble, and planting larger blocks of wheat to minimize the severe infestations found in field edges.

Q: What research is being conducted at CSU in response to the wheat stem sawfly outbreak?

A: CSU is emphasizing the development of high quality, productive wheat varieties resistant to wheat stem sawfly. Other research projects include screening for novel sources of resistance, improving biological controls, testing the use of trap crops, and trying new approaches to chemical control. We also conduct surveys to track the spread of this pest, to help growers see if their regions are hotspots for infestation.

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Additional Resources:

https://wiki.bugwood.org/HPIPM:Wheat_Stem_Sawfly <https://extension.colostate.edu/topic-areas/insects/wheat-stem-sawfly-a-new-pest-of-colorado-wheat-5-612/>

<https://www.ag.ndsu.edu/publications/landing-pages/crops/wheat-stem-sawfly-c-1479>

More information available at www.csuwheatentomology.com