Working Paper

Colorado Farmer Strategies for Addressing Wheat Stem Sawfly Risks:

Strategies and Regional Patterns from a 2023 Producer Survey

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Introduction

The wheat stem sawfly (WSS, *Cephus cinctus*) emerged as a significant threat to winter wheat producers in Colorado in 2010, with the primary concentration of infestations in NE Colorado. **Figure 1** shows the average percentage of wheat stem sawfly infestation across Colorado from 2019 to 2024. Infestation was 15% in 2019 and 2020, declined to a low of 7% in 2021, and then increased sharply to 21% in 2022. After a slight decline to 14% in 2023, infestation increased again to 27% in 2024, the highest rate observed in recent history. These fluctuations may reflect variations in weather conditions, crop management practices, or sawfly population dynamics across years. The total economic impact of yield losses due to WSS average approximately $70 million per year over the 2019–2022 period (Wasserman-Olin et al., 2023). If unmanaged, infestations can result in yield losses between 15% and 40%, significant revenue losses on top of the additional costs for implementing various pest management strategies.

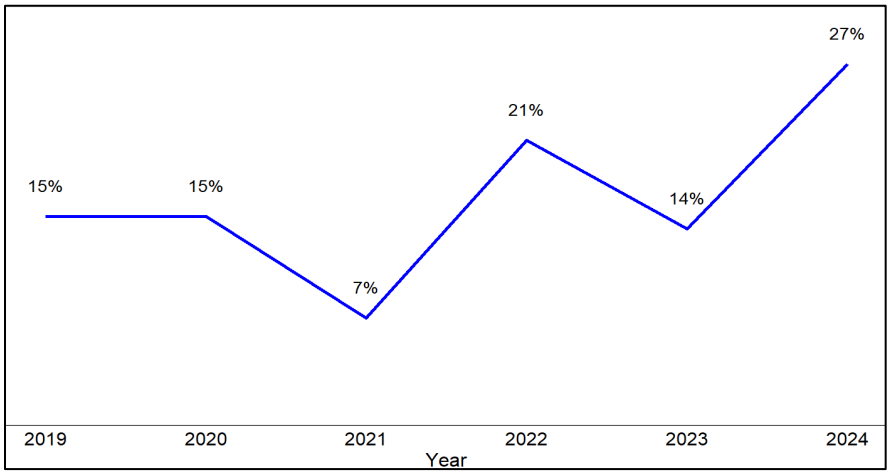

Figure 1: Trends in Wheat Stem Sawfly Infestation in Colorado, 2019–2024.
Note: The data is an average of 100 field sites with 100 wheat stems dissected per site.
Data Source: CSU Wheat Entomology Research Program

Note: Each year, CSU Wheat Entomology collects field data on wheat stem sawfly infestation across Colorado counties. The statewide infestation percentage was calculated as the total number of infested stems (i.e., stems containing live larvae, dead larvae, or frass only) divided by the total number of stems dissected (including infested and empty stems).

In 2023, 51 wheat farmers in Colorado were surveyed to study the potential economic impact of wheat stem sawfly in Colorado, as well as to understand adoption patterns of prevention management practices used by the farmers. Of these farms, 29 farms were managed within a single county, while 22 were managed across multiple counties[1]. **Figure 2** shows the number of farms by county from this dataset, and **Table 1** provides the underlying data.

[1] To account for multi-county farms, we evenly divided each farm's reported total acreage in all crops and wheat acreage across the counties it operated in. For instance, if a farm operated in three counties with a total of A acres, we assigned A/3 acres to each county. After splitting the acreage by county, we removed all non-Colorado farm segments. These included farms based in Nebraska or those that

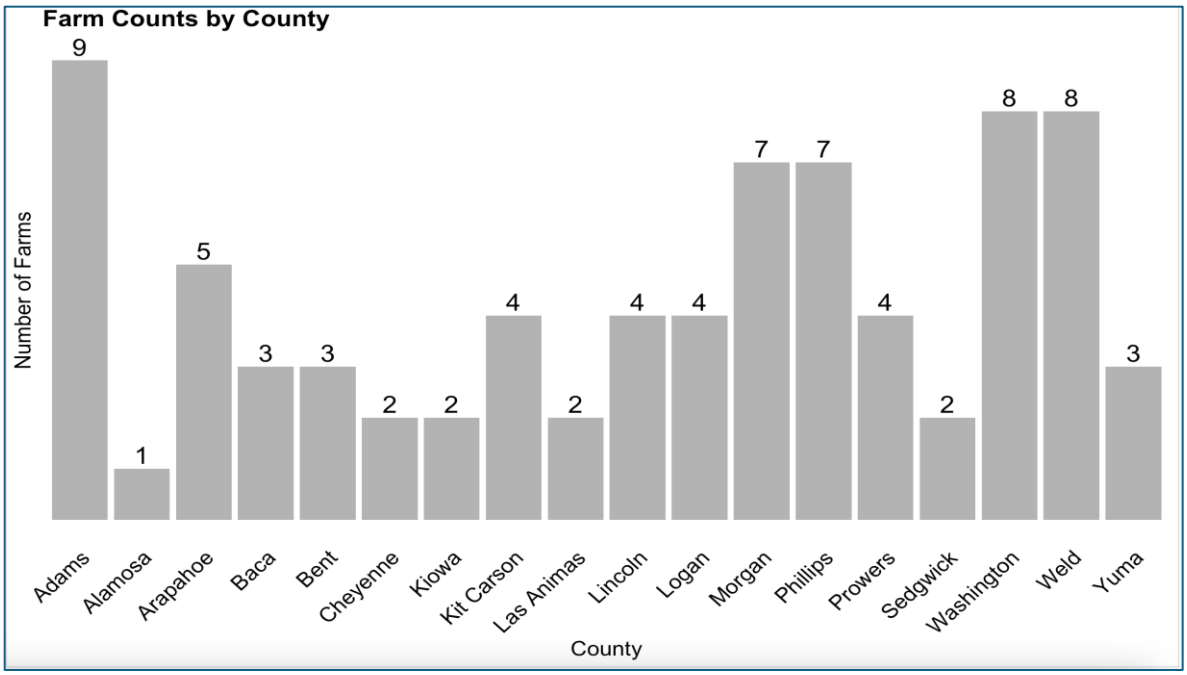

Figure 2: Number of farms by county

Note: 1) **Single-county farms** were directly counted based on the number of farms reporting operations in only one county. 2) **Multi-county farms** were assigned to each county they reported operations in, ensuring that all counties where a farm was active were included, making the above number of farms add to more than the 51 survey responses. 3) Counties of Nebraska are excluded from further analysis.

Table 1: Farm Counts by County

COUNTY	Farm Count from Single County	Farm Count from Multi-County	Total Farm in the County
Adams	2	7	9
Arapahoe	2	3	5
Baca	3	0	3
Cheyenne	1	1	2
Kit Carson	4	0	4
Las Animas	2	0	2
Lincoln	1	3	4
Logan	1	3	4
Nebraska	1	1	2
Phillips	3	4	7
Prowers	1	3	4
Washington	4	4	8
Weld	3	5	8
Yuma	1	2	3
Alamosa	0	1	1
Bent	0	3	3
Kiowa	0	2	2
Morgan	0	7	7
Sedgwick	0	2	2

Note: 1) **Single-county farms** were directly counted based on the number of farms reporting operations in only one county. 2) **Multi-county farms** were assigned to each county they reported operations in, ensuring that all counties where a farm was active were included. 3) Nebraska and Chase County were excluded from further analysis.

General Demographics of the survey respondents

Table 2 represents the sample demographics at the county level alongside state-level data from the 2022 USDA Census of Agriculture. The average age in the sample is 50, compared to 53 statewide. Weighted annual revenue is $1.06 million in the sample and $7.92 million at the state level, indicating that our sample represents approximately 13.4% of total statewide sales. The sample includes 84% male and 12% female producers, while the state-level distribution is 59% male and 41% female. White producers make up 90% of the sample, compared to 97.5% statewide.

Table 2: Survey Sample Representativeness

Farmers Characteristics	Survey Data	State-Level
Age(years) [+]	50	53
Annual Average Revenue ($) [+]	1,056,300	7,920,100
Gender		
Female	12%	41%
Male	84%	59%
Non-binary	2%	
Prefer not to say	2%	
Race		
White	90%	97.5%
Others [++]	10%	2.5%

Notes: 1) N = 50 for survey data (pre-split farms), with 1 farm managed in Nebraska and excluded from this study. Demographics were calculated using the original dataset before separating single and multi-county farms because splitting farms would duplicate characteristics like gender, race, and age. 2) State-level data reflects aggregate producer-level statistics from USDA/NASS 2022 Census of Agriculture County Profile. Non-binary and "prefer not to say" responses each account for 2% in the sample 3) [+] Weighted annual revenue and average age were calculated using predefined categorical ranges. Revenue was reported in seven categories, beginning with "$10,000–$49,999" and ending with "$5,000,000 and over." Each category was assigned a midpoint value to approximate average income. Age was reported in three groups: 18–35, 35–64, and over 64. Midpoints of 26.5 and 49.5 were used for the first two groups, and the lower age range (64) was used for the oldest group. Weighted averages were calculated by multiplying each midpoint by the number of farmers in the respective category and dividing the total by the number of farmers. 4) [++] Other races included in the survey are Black and Hispanic.

Prevention Measures Used by the Farmers

Table 3 presents summary statistics for WSS prevention strategies reported by farmers across the entire sample. For instance, a mean value of 46% for increasing crop diversification indicates that 46% of surveyed farmers adopted this practice. Among the listed strategies, increasing diversification and planting semi-solid or solid stem wheat varieties were the most used prevention measures. These were followed by practices such as planting larger blocks of wheat and avoiding previously infested areas. The least used measures included insecticide application, reduced tillage, edge trap cropping, and other methods such as undercutting and seed treatment. The table also includes responses to infestation history and perceived threats. Sixty percent of the farmers reported having experienced sawfly infestation in the past, and 86% viewed sawfly as a threat. These findings support the concept that we are likely to note the adoption of multiple prevention strategies in high-pressure areas.

Table 3: Summary Statistics of the Prevention Measures used by farmers

Measures	Mean

Past Infestation	
Yes	60%
No	34%
Don't Know	6%
Sawfly a Threat	
Yes	86%
No	14%
Prevention Measure	
Increase Diversification	46%
Solid/Semi-solid Varieties	44%
Plant Larger Blocks of Wheat	30%
Avoiding Past Infested Areas	10%
Swathing	18%
Increase Insecticide Use	8%
Less No-Till	14%
Other Measures^{+}	6%
Edge Trap Crop	2%

Note: other measures $^{+}$ includes undercut, tread mulch, Winrow, and seed treatment. 1) N = 50 for survey data (pre-split farms), with 1 farm managed in Nebraska and excluded from this study. Prevention measures statistics were calculated using the original dataset before separating single and multi-county farms because splitting farms would duplicate these adoption measures.

County patterns further support this interpretation. Counties with a high share of farmers reporting past infestation-such as Adams, Logan, Sedgwick, Yuma and Morgan also reported high perceived threat and relatively widespread use of prevention measures like diversification, solid or semi-solid varieties, and planting larger blocks of wheat. In contrast, counties like Kiowa, Cheyenne, and Bent, which reported no past infestation, also reported no adoption of prevention practices and low perceived threat. These differences show that farmers are more likely to use prevention strategies when they've dealt with sawfly problems in the past. This highlights the importance of targeted outreach and early warnings in counties with little or no sawfly pressure yet but could be at risk in the future.

Regional analysis

To look at regional comparisons, we identified the CSU Extension region for each farmer based on the county in which they managed their farmland and then grouped them responses into three CSU regions (using designations adopted by CSU Extension): Front Range, Northeast, and South regions. **Table 4** summarizes sawfly-related responses by CSU Extension region, highlighting the regional differences in past infestation, perceived threat, and adoption of prevention strategies.

Ninety-one percent of farmers in the Front Range and 82% in the Northeast region reported past sawfly infestation, whereas only 6% of farmers in the South reported the same. Despite the low reported infestation in the South, 71% of farmers there still viewed sawfly as a threat, though this is lower than the 95% reported in both the Front Range and Northeast. Adoption of prevention practices followed similar patterns. Farmers in the Front Range and Northeast reported the highest adoption rates, with over 50% reporting the use of solid or semi-solid stem wheat varieties and increased crop diversification. In contrast, adoption was considerably lower in the South, where few respondents reported using any of the listed strategies. Measures like reduced or no tillage, avoiding previously infested areas, and swathing were more commonly practiced in the Front Range, while edge trap crops remained largely unused across all regions.

These findings suggest that while awareness of sawfly as a threat is widespread, actual prevention efforts vary significantly by region likely reflect the differences in previous infestation experiences.

Table 4: **Summary Statistics by CSU Regions**

Regions	**Front-range**	**Northeast**	**South**
No of Counties	3	8	4
No of farms	22	39	17
Sawfly			
Past Infestation			
Yes	91%	82%	6%
No	4.5%	18%	82%
Don't Know	4.5%	0%	12%
Sawfly a Threat			
Yes	95%	95%	71%
No	5%	5%	29%
Prevention Measures			
Edge Trap Crop	0%	5%	0%
Increase Diversification	59%	54%	18%
Solid/Semi solid varieties	59%	62%	6%
Larger Blocks	45%	36%	6%
Less or No Till	36%	8%	0%
Avoiding Past Infested Areas	23%	18%	0%
Increase Insecticide	9%	8%	6%
Swathing	23%	23%	0%
Edge Trap Crop	0%	5%	0%
Others [++]	14%	5%	0%

This regional pattern is further illustrated in **Figures 3 and 4. Figure 3** shows the proportion of farmers reporting past wheat stem sawfly infestation (left panel) and perceived threat of sawflies (right panel) across Colorado regions. The Front Range and Northeast report high levels of both past infestation and perceived threat, while the South shows lower concern. **Figure 4** complements this by highlighting greater adoption of prevention practices in the Front Range and Northeast particularly diversification and use of solid-stem varieties compared to limited adoption in the South. These patterns suggest that farmers in higher-pressure regions are more likely to implement multiple prevention strategies and treat the sawfly as a serious concern.

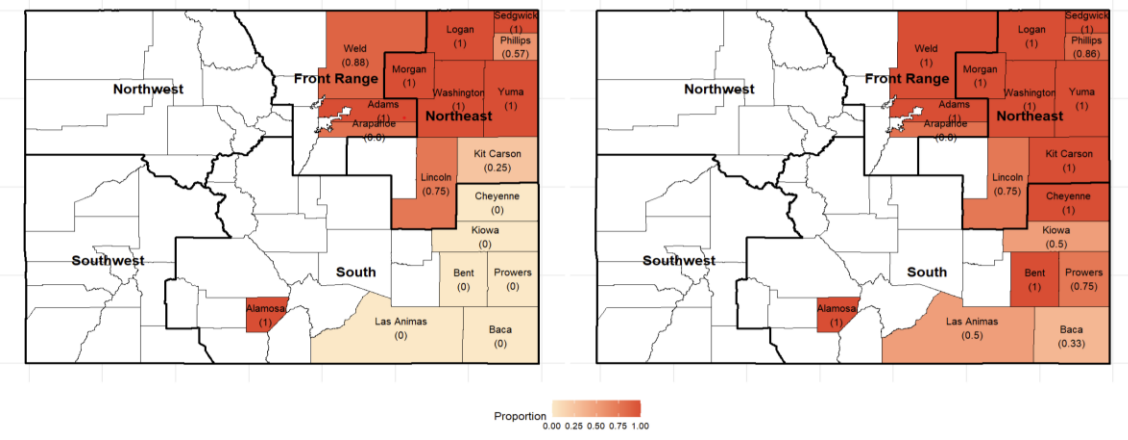

Figure 3: Past Sawfly Infestation (Left) and Perception of Wheat Stem Sawfly as a Threat (Right)

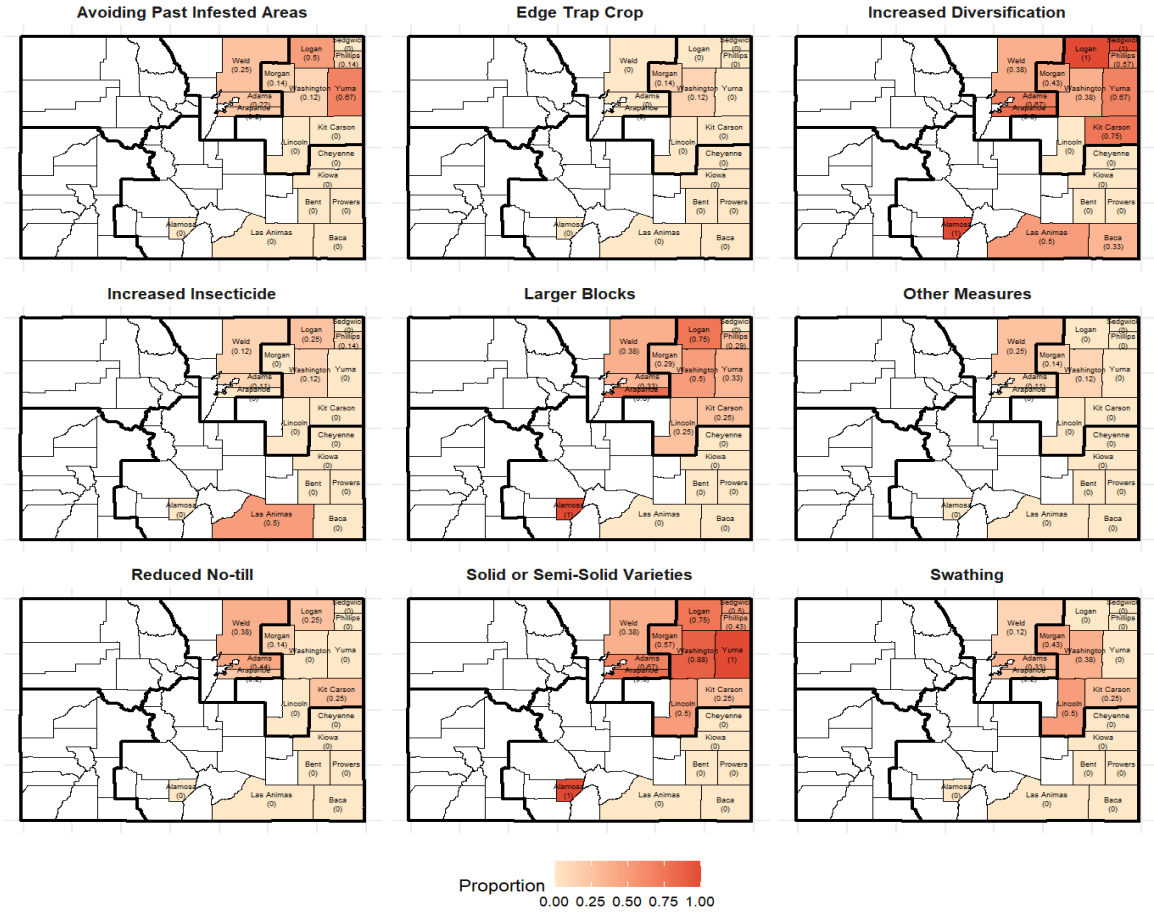

Figure 4: Wheat Stem Sawfly Prevention Measures by County

Future Work

As WSS infestation rates continue to rise, it is crucial to understand how farmers have adapted their management strategies compared to two years ago, when pest pressure was lower. Building on the findings from this study, we conducted a follow-up farmer survey in summer 2025 to document changes in prevention practices, perceptions of risk, and adoption of new management strategies in response to increasing infestation levels. Moving forward, we aim to re-assess the economic impact of wheat stem

sawfly in Colorado, considering the evolving adoption patterns of solid-stem wheat varieties among producers.

Acknowledgement

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