## Oregon IPM Center Phenology/Degree-Day Model Implementation – June 10, 2025

Wheat stem sawfly Cephus cinctus (Hymenoptera: Cephidae)

Implementation of the CSU model published April 2025



Egg

- Larva Adam Osterholzer and Gabriel Alnajjar, CSU
- Adult Ken Gray Photo Collection

Source 1. Vieira, H.V., B. Z. Bradford, A. Osterholzer, E. S. Peirce, D. Cockrell, F. Peairs, K. Frost, R. Groves, and P. Nachappa. 2025. A new growing degree-day phenology model for wheat stem sawfly (Hymenoptera: Cephidae) in Colorado wheat fields. PlosOne. https://doi.org/10.1371/journal.pone.0320497

Fig. 3. GLM/GAM derived WSS emergence phenology model.





Fig. 4. Probit fit of the cumulative proportion of total WSS captures over cumulative growing DD.

Source 2. Perez-Mendoze, J. and D. K. Weaver. 2006. Temperature and relative humidity effects on postdiapause larval development and adult emergence in three populations of wheat stem sawfly (Hymenoptera: Cephidae). Environ. Entomol. 35:1222-1231.

## Table 2. Post Diapause development vs. temperature

- Take average of results from 3 locations and 3 RH ranges (drop outliers which developed more slowly than average)

- Solve LDT and DD requirements based on linear regression with additional forcing point to reach 10C LDT (lower developmental temperature) as used by source #1

|          |                               |                                     |      | Days post | -diapause d | levelopmen | t from larv | a to adult |          |           |          |          |
|----------|-------------------------------|-------------------------------------|------|-----------|-------------|------------|-------------|------------|----------|-----------|----------|----------|
|          | Temp. C                       | 1/days                              | Days | Pop 1 (Co | nrad MT)    |            | Pop. 2 (O   | pheim MT)  |          | Pop. 3 (A | msterdam | MT)      |
| forcing: | 11.15                         | 0.0001                              | Avg. | RH 43%    | RH 53-61    | RH 75-76   | RH 43%      | RH 53-61   | RH 75-76 | RH 43%    | RH 53-61 | RH 75-76 |
|          | 15                            | 0.023                               | 42.8 | 41.3      | 40.9        | 43.3       | 45.3        | 46.5       | 44.4     | 39.2      | 39.7     | 44.5     |
|          | 20                            | 0.042                               | 24.0 | ) 23.5    | 22.1        | 22.2       |             |            | 32.5     | 22        | 23.8     | 22       |
|          | 25                            | 0.054                               | 18.5 | 5 17.7    | 19.6        | 16.1       |             |            |          | 19.5      | 19.5     | 18.7     |
|          | 30                            | )                                   | 18.9 | 19.3      | 18.3        | 16.6       | 23.6        | 22.5       |          | 17.9      | 16.5     | 16.8     |
| DDC:     | slope<br>intercept<br>1/slope | 0.0038241<br>-0.038241<br>261.50092 | F    |           |             |            |             |            |          |           |          |          |

## x-intercep-b/a 10.000144 50.00026 Rsq 0.964013 Wheat stem sawfly w/forcing x-intercept Wheat stem sawfly - no forcing x-intercept 0.06 0.060 f(x) = .0038 x - .0382f(x) = 0.0031 x - 0.02161 0.05 $\hat{R}^2 = .9640$ 0.050 $\hat{R}^2 = 0.9878$ 0.04 0.040 1/days 0.03 1/days 0.030 0.02 0.020

Results: dropping 30C and 5 outlier points (at 20 & 25C), adding a point to force a 10C LDT results in rather good fit (Rsq=0.96), supporting the CSU selection of this LDT. Note a slightly lower LDT of 8.88C (48F) provides a better fit of Rsq=0.99. Further investigation for establishment of the best LDT appears warranted.

30

35

0.010

0.000

14

16

18

20

22

Temp. C

24

26

28

30

32

The resulting DDC10 of 261 for post-diapause development provides some validation of the CSU peak emergence value 224 DDC

20

Temp. C

25

15

| lodel Summary              |  |            |  |  |  |  |  |  |  |  |
|----------------------------|--|------------|--|--|--|--|--|--|--|--|
| Species: Cephus cinctus    |  |            |  |  |  |  |  |  |  |  |
| Common Name: Wheat s       | Common Name: Wheat stem sawfly                                 |            |  |  |  |  |  |  |  |  |
| Country of Origin, data fr | om: Colorado (Vieira et al. 202                                | 25)        |  |  |  |  |  |  |  |  |
| Pest of: Wheat             |  |            |  |  |  |  |  |  |  |  |
| Validation Status: Develo  | Validation Status: Developed and validated in Eastern Colorado |            |  |  |  |  |  |  |  |  |
|                            | Celsius  | Fahrenheit |  |  |  |  |  |  |  |  |
| Lower Threshold:           | 10.0   | 50.0       |  |  |  |  |  |  |  |  |
| Upper Threshold:           | 30.0   | 86.0       |  |  |  |  |  |  |  |  |
| Calculation Method:        | Single sine  |            |  |  |  |  |  |  |  |  |
| Model Start:               | 1 Jan  |            |  |  |  |  |  |  |  |  |
| Degree-Day Requirement     | s Celsius  | Fahrenheit |  |  |  |  |  |  |  |  |
| First adult flight         | 148  | 266        |  |  |  |  |  |  |  |  |
| Peak adult flight          | 224  | 403        |  |  |  |  |  |  |  |  |
| End of adult flight        | 354  | 637        |  |  |  |  |  |  |  |  |

0.01

0

10