Thermal biology and adult emergence of the red sunflower seed weevil, *Smicronyx fulvus* LeConte

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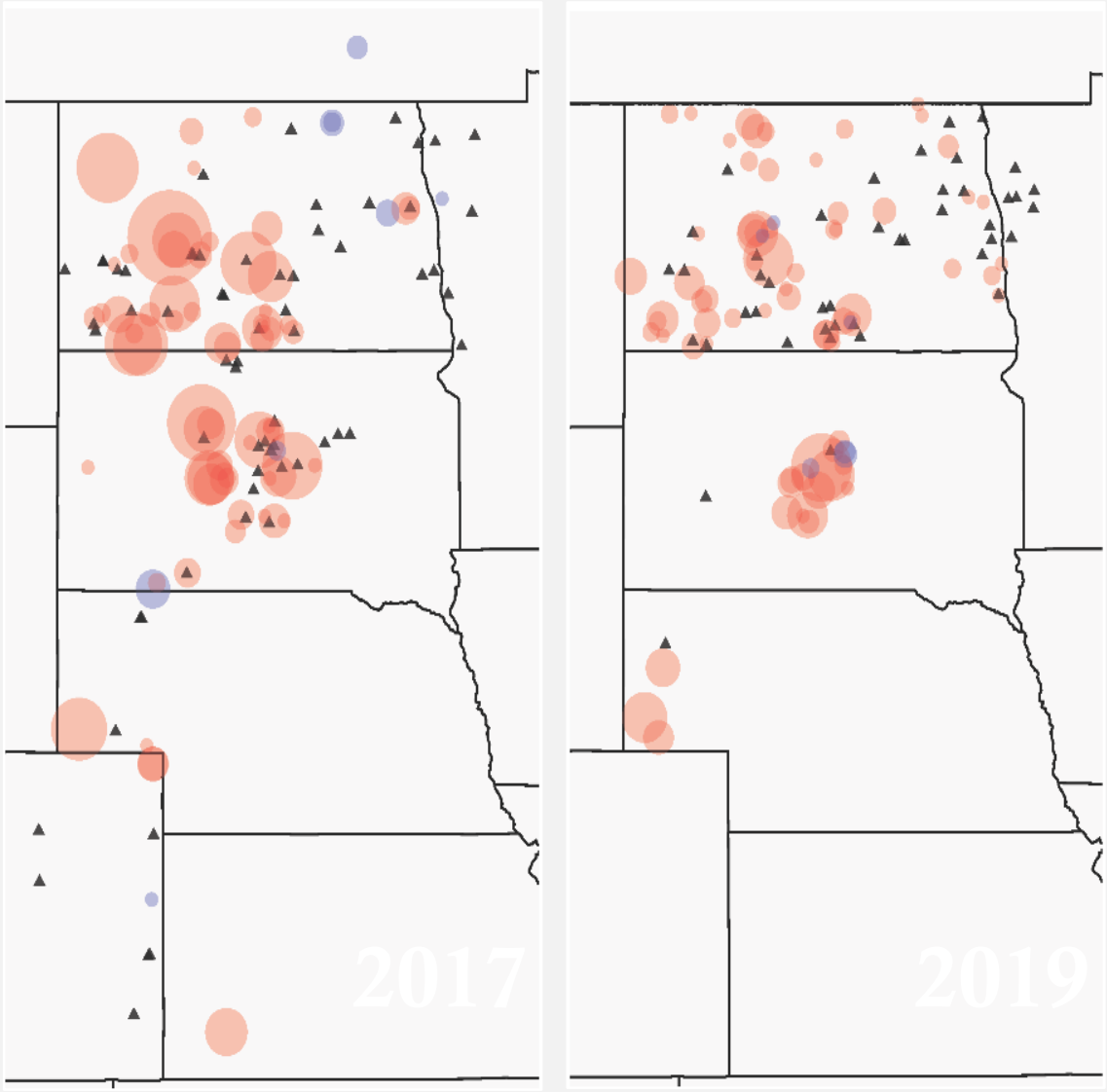
Red Sunflower Seed Weevil *Smicronyx fulvus* LeConte

- #1 seed feeding pest in NSA survey (2017, 2019)
- Eggs laid inside achenes, reduce oil content
- Reliance on insecticides
- One generation per year
- Overwinter in soil
- Highest mortality in soil?

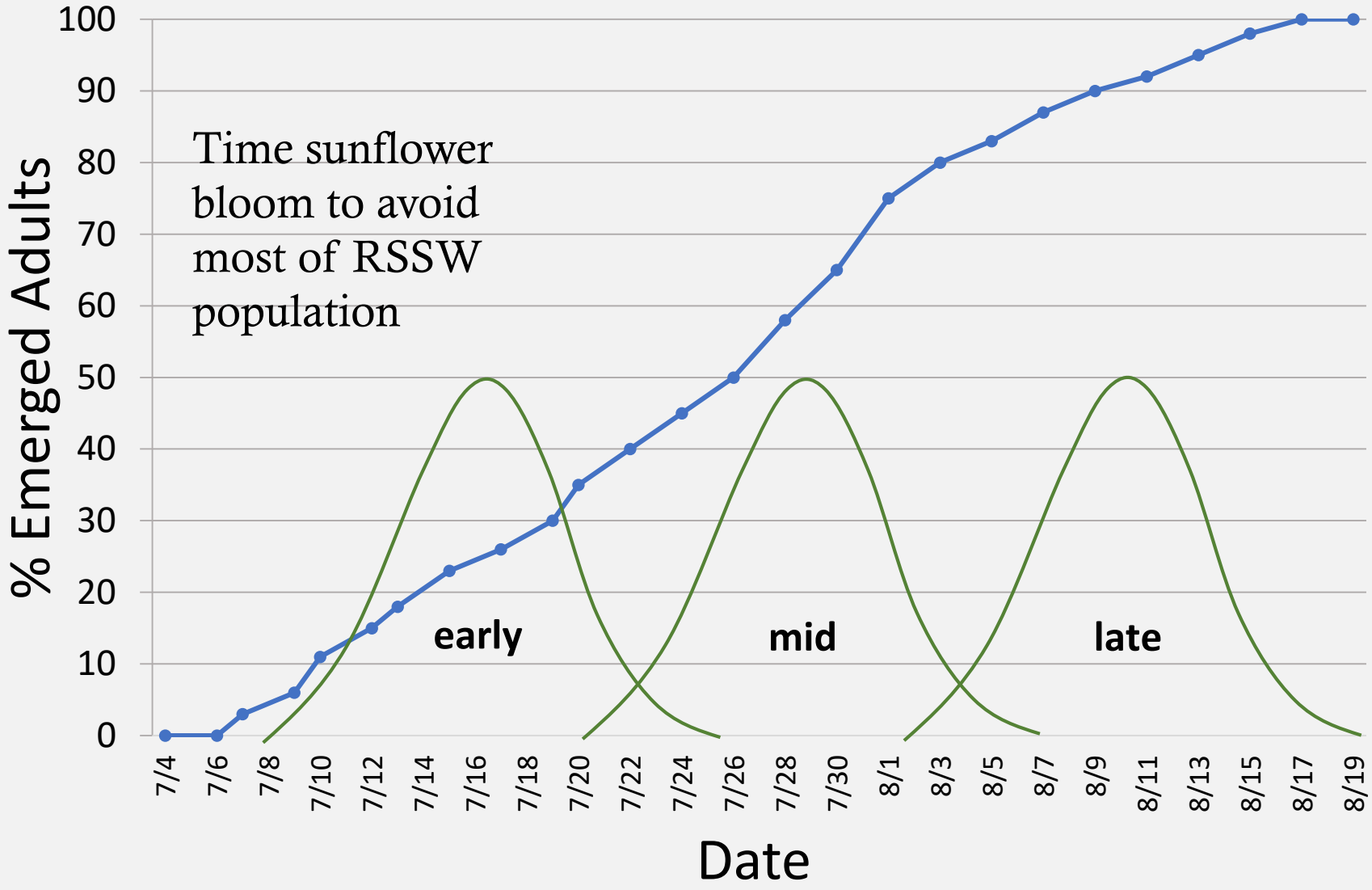


Red Sunflower Seed Weevil

- Circles - % of damaged seed
- Triangles - fields with no damage
- 2017 – seed weevil, 83% of damaged seed
- 2019 – seed weevil, 75% of damaged seed

1	2	3	4	5	6	7	8	9	10	11	12
											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
overwinter in soil as larvae	overwinter in soil as larvae	overwinter in soil as larvae	soil thaws, break diapause	soil thaws, pupation starts	pupation	emerge as adults, lay eggs	emerge as adults, lay eggs	developing larvae feed on seed, exit head	larvae exit head, start overwintering	overwinter in soil	overwinter in soil

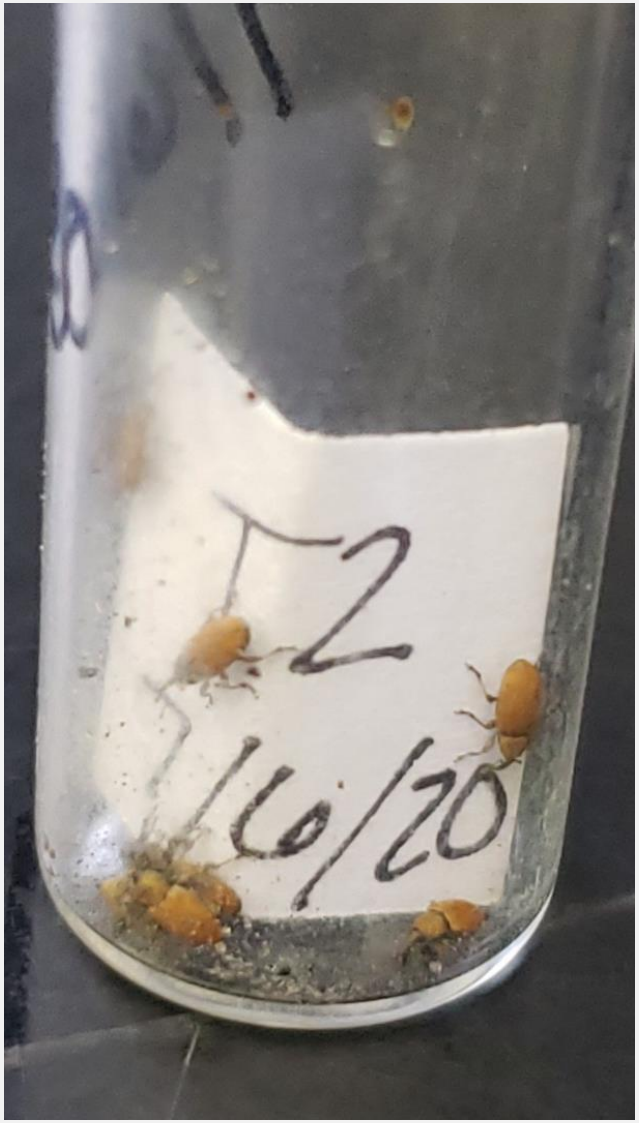
Emerged Adults & Sunflower Bloom Date



Objectives

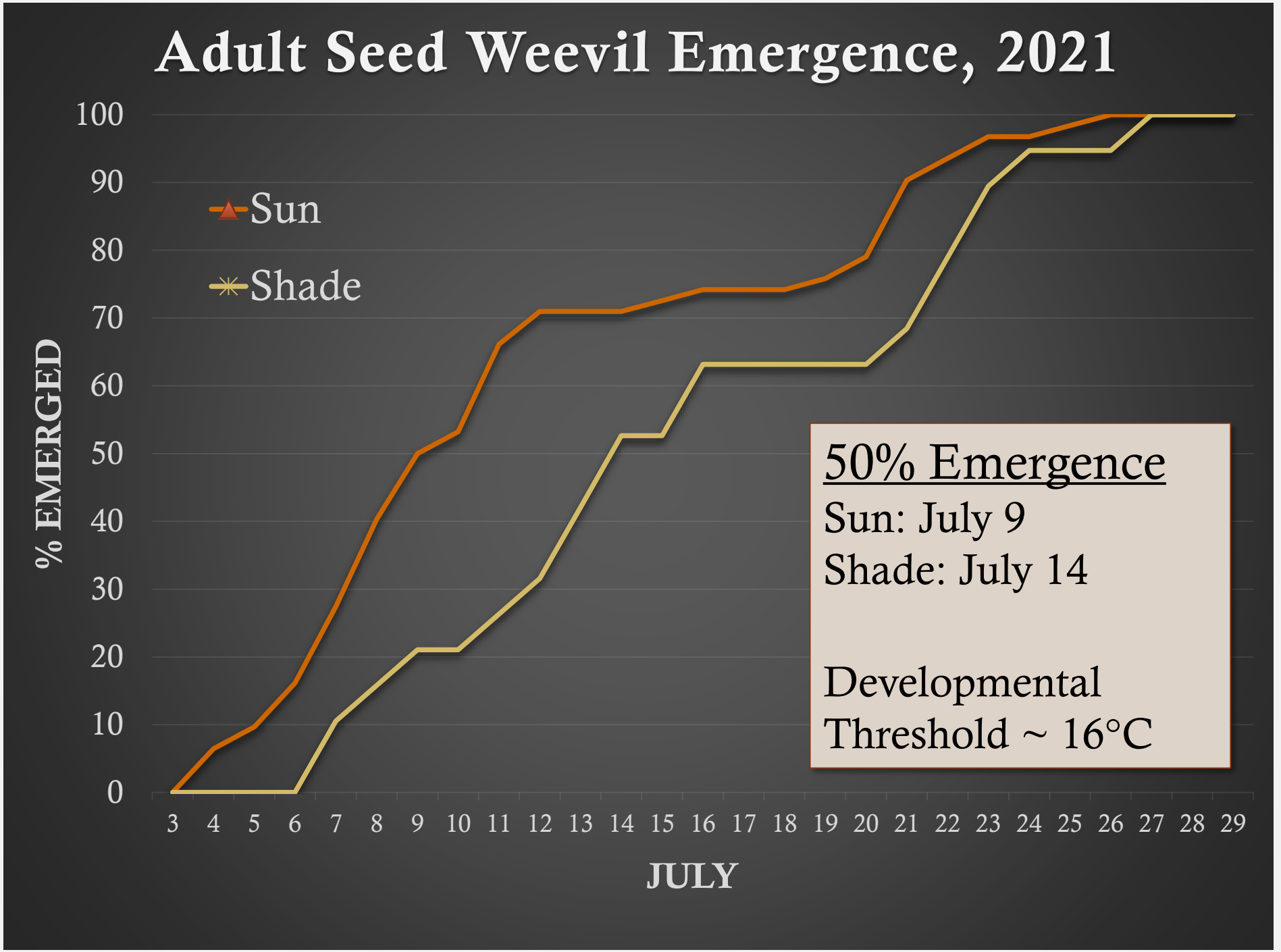
1) Determine adult emergence dates
2) Determine the freezing point of larvae
3) Determine soil depth of larvae during the winter

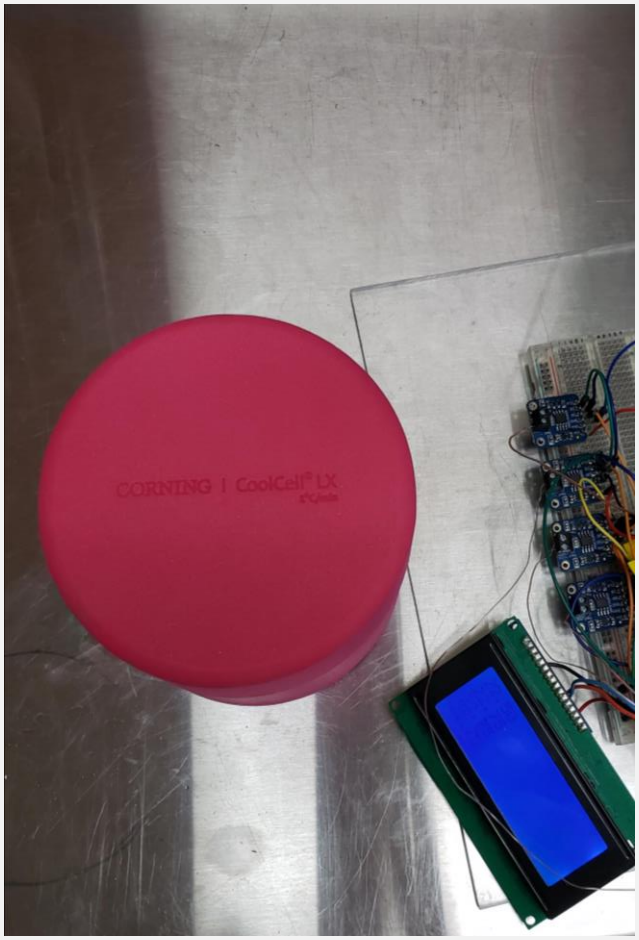
Understanding of overwintering mortality



Methods – Adult Emergence

- Weevil larvae in the field in September
- Overwinter in the field, traps put out in May
- Traps monitored for first emergence
- Adults collected and counted by date and trap

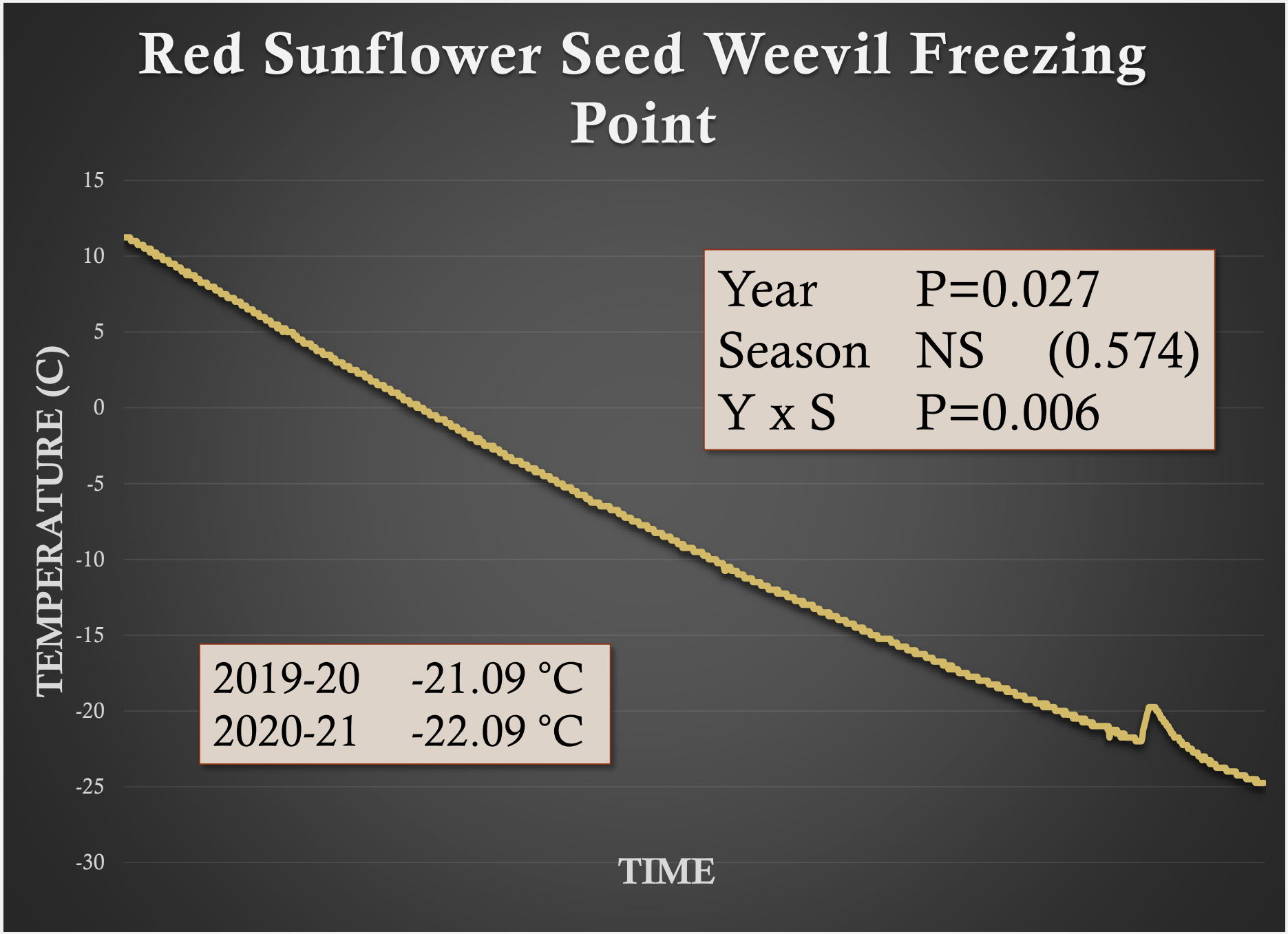

Adult Seed Weevil Emergence, 2021
100
90
80
70
60
50
40
30
20
10
0
% EMERGED
Sun
Shade
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
JULY
50% Emergence
Sun: July 9
Shade: July 14
Developmental Threshold ~ 16°C

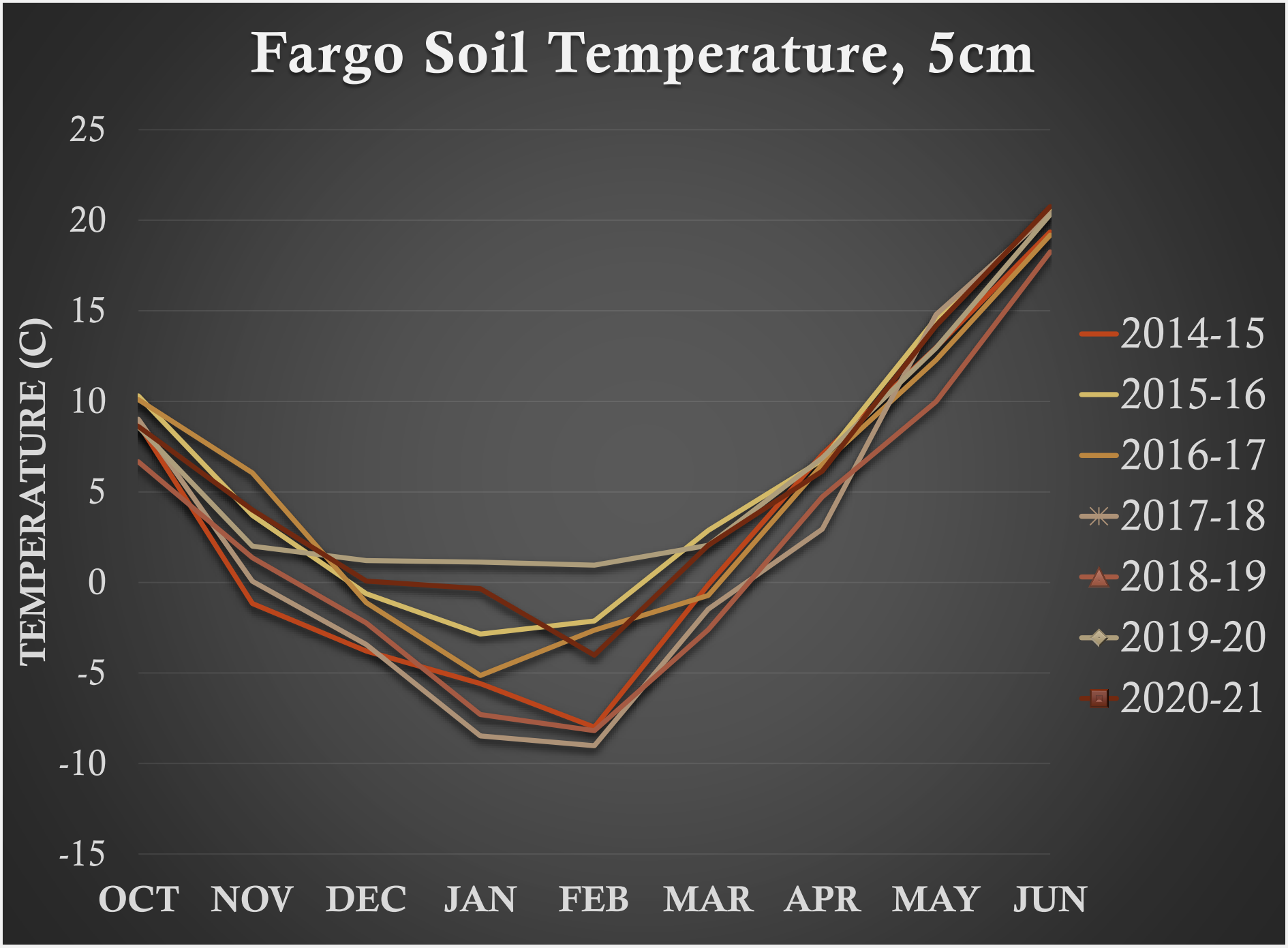


Methods – Freezing Point

- Collection of weevil adults
- Artificial infestation in field plot
- Collection of larvae
- Cold storage indoors
- Freezing: November, January, April, June

Red Sunflower Seed Weevil Freezing Point



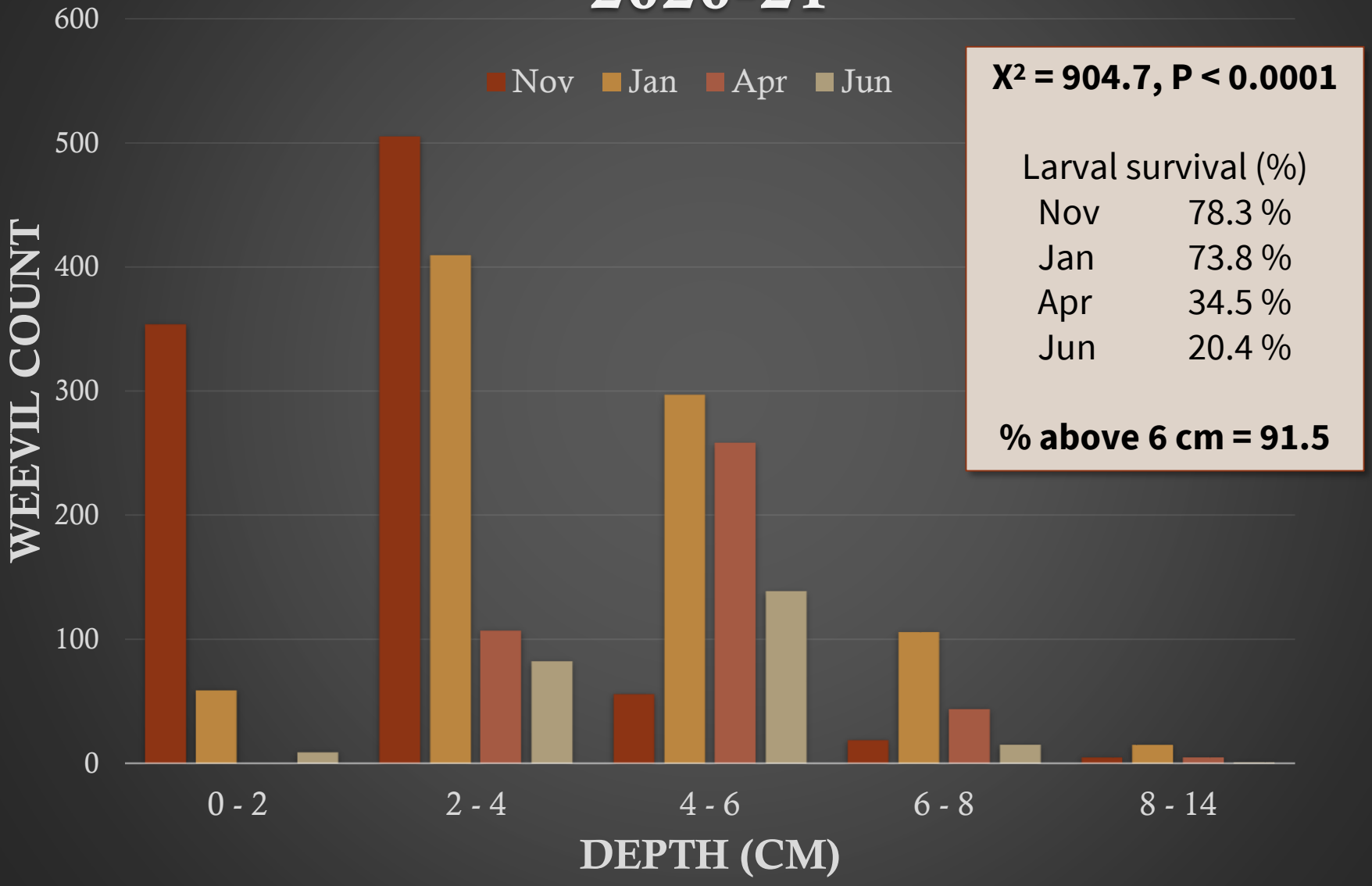

Fargo Soil Temperature, 5cm
TEMPERATURE (C)
25
20
15
10
5
0
-5
-10
-15
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
2014-15
2015-16
2016-17
2017-18
2018-19
2019-20
2020-21

Methods – Overwintering Depth

- Weevil larvae in the field in September
- Overwinter in the field
  - November, January, April, June
- Larvae collected and counted every 2cm
- Contingency table


cm 1 2 3 4 5

Overwintering Depth by Month, 2020-21

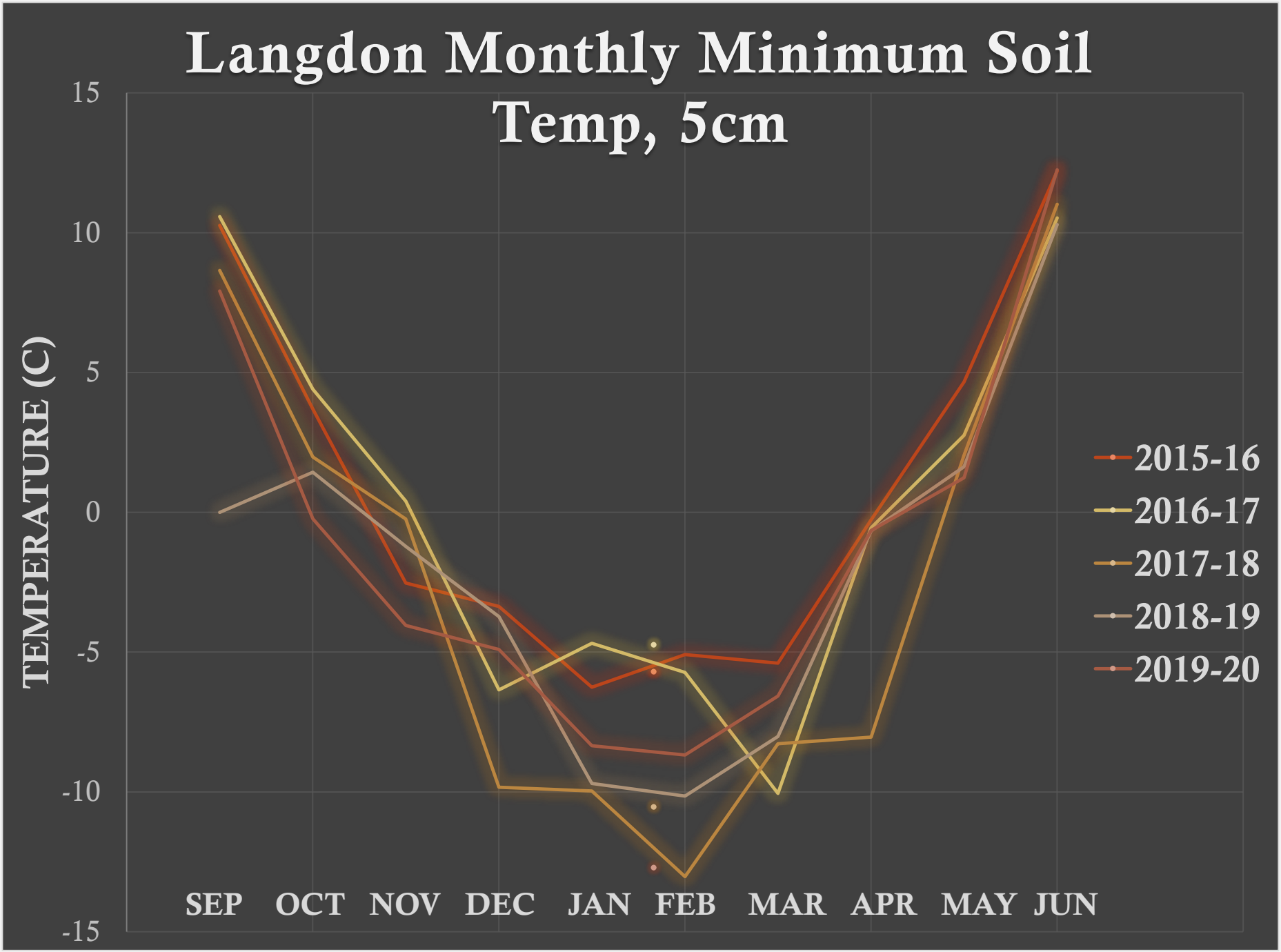


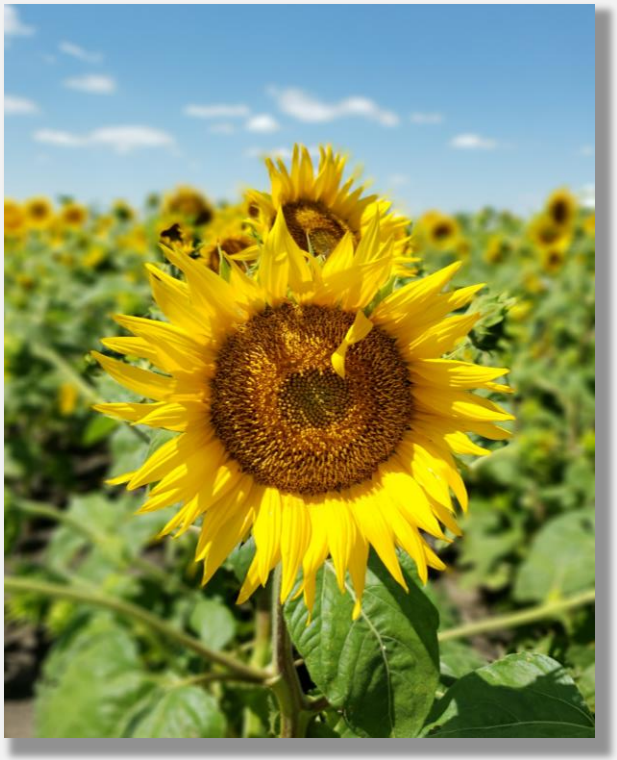
$X^2 = 904.7$, $P < 0.0001$

Larval survival (%)

Nov	78.3 %
Jan	73.8 %
Apr	34.5 %
Jun	20.4 %

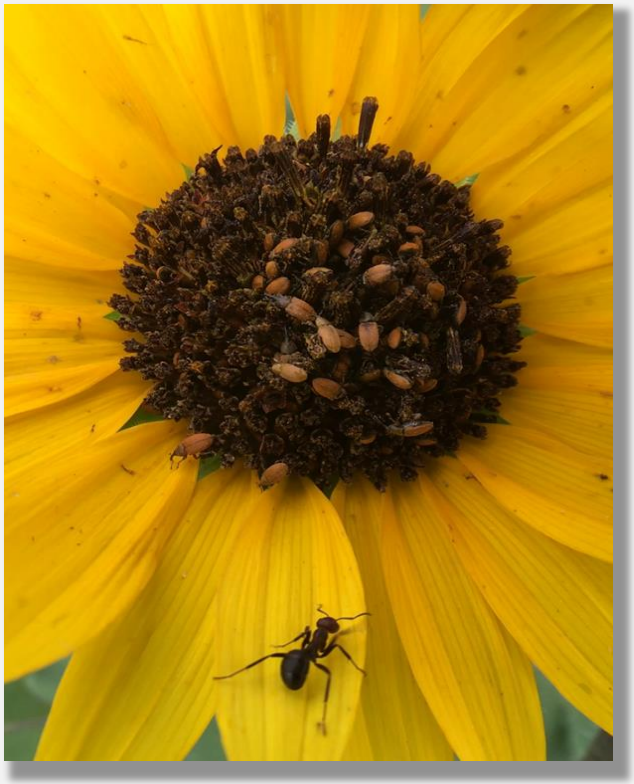
% above 6 cm = 91.5


Langdon Monthly Minimum Soil Temp, 5cm
15
10
5
0
-5
-10
-15
TEMPERATURE (C)
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
2015-16
2016-17
2017-18
2018-19
2019-20



Conclusions

- RSSW larvae freeze at ≈ -21ºC (-5.8ºF)
  - Soil min. -15ºC
- Overwinter 0-6cm (91.6%)
- Mortality between Jan/Apr
  - Sublethal temperature exposure
  - Shallow larvae vulnerable
- Adults emerged over a two-week period
  - 50% by July 9: sun
  - 50% by July 14: shade
- Wild caught adults in ND appeared 10-14 days later
- Developmental Threshold, ~ 16ºC



Future Work

- Degree-day model
  - emergence, developmental threshold
- Planting date demonstration

Acknowledgements

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Committee

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