

# Pyrethroid Resistant Red Sunflower Seed Weevils Confirmed in South Dakota

**Adam Varenhorst:** Associate Professor and SDSU Extension Field Crop Entomologist  
SDSU: Aaron Hargens, Philip Rozeboom, Patrick Wagner  
NDSU: Janet Knodel, Patrick Beauzay, T. J. Prochaska, Ryan Buetow

# Red sunflower seed weevils

- Annual pest of SD sunflower
- Severe infestations can result in 50-80% of achenes being infested
  - Larvae feed on developing kernel
- Primarily managed using pyrethroid insecticides



# The problem?

- Field outbreaks 10-100x over threshold
- Reported field insecticide failures



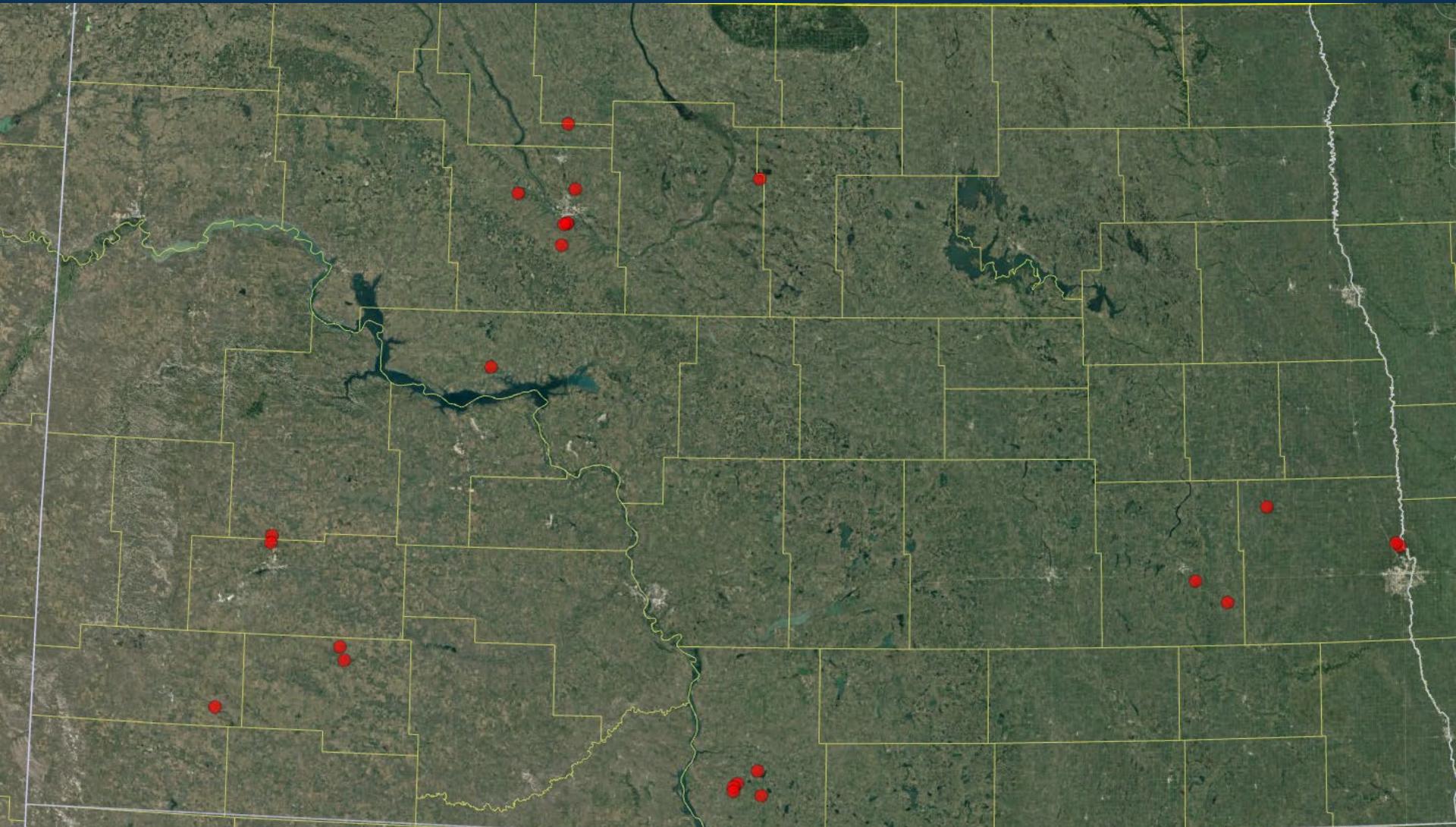
# The problem?



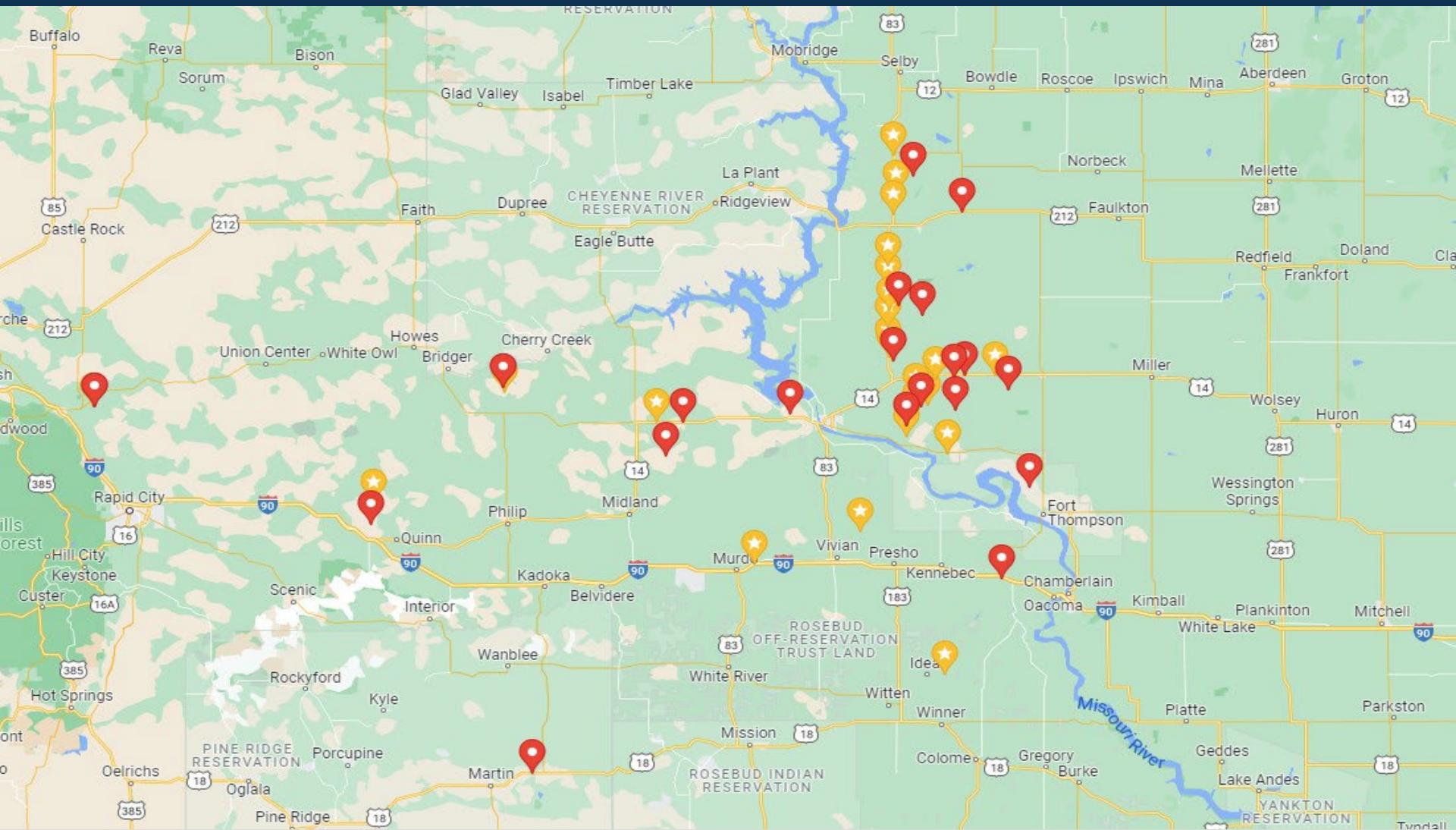
# The problem?

- Pyrethroids
- Failures reported: 2017, 2018, 2019, 2020, 2021, 2022
- Reduced pyrethroid susceptibility observed in 2020, 2021, 2022 (SDSU and NDSU data)
- Large persistent populations in SD

# ND Fields 2020-2022

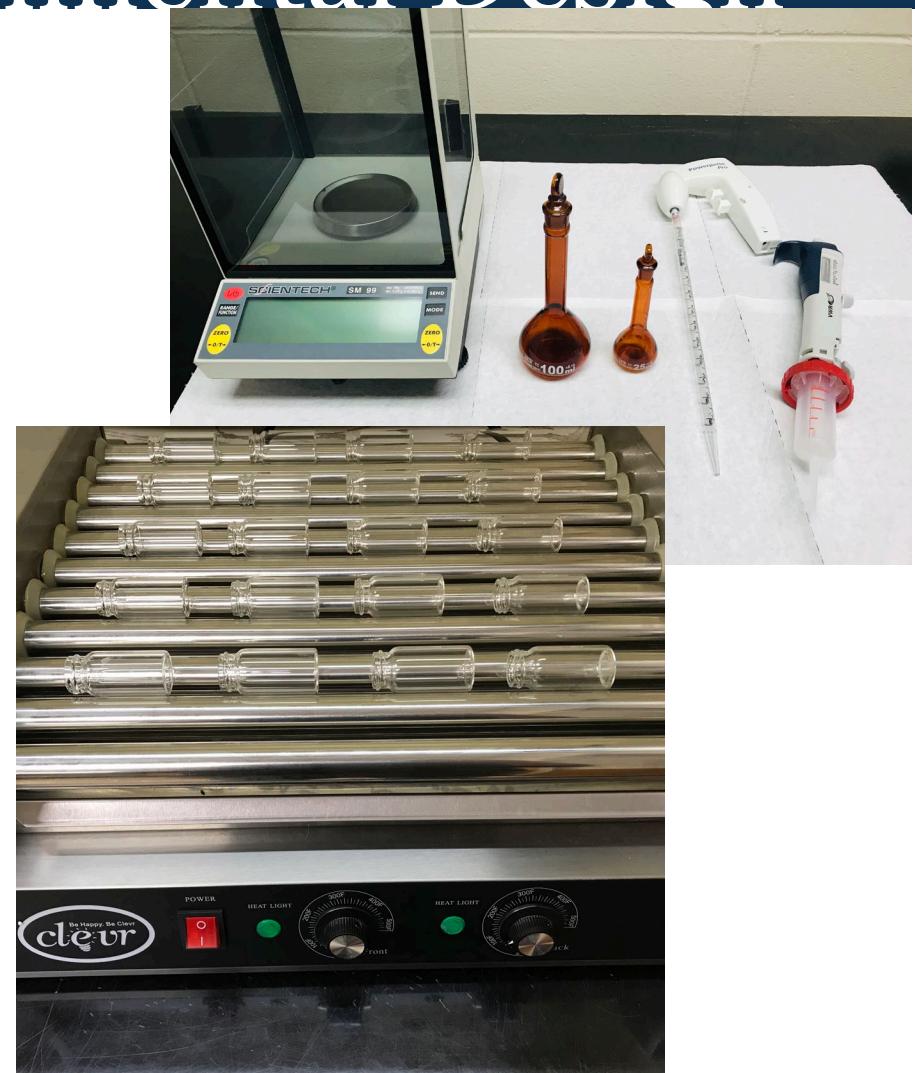


# SD Fields 2021-2022



# Bioassay Experimental Design

- Glass vial bioassay
- 4 treatments:
  - Control, Lambda-cyhalothrin (Warrior II), Esfenvalerate (Asana XL), Esfenvalerate + Piperonyl Butoxide (Exponent) synergist
- Treatment doses extrapolated from product field rates
- Lambda-cyhalothrin (1.92 fl oz/acre) = 13.4 ug/vial
- Esfenvalerate (9.6 fl oz/acre) = 21.2 ug/vial

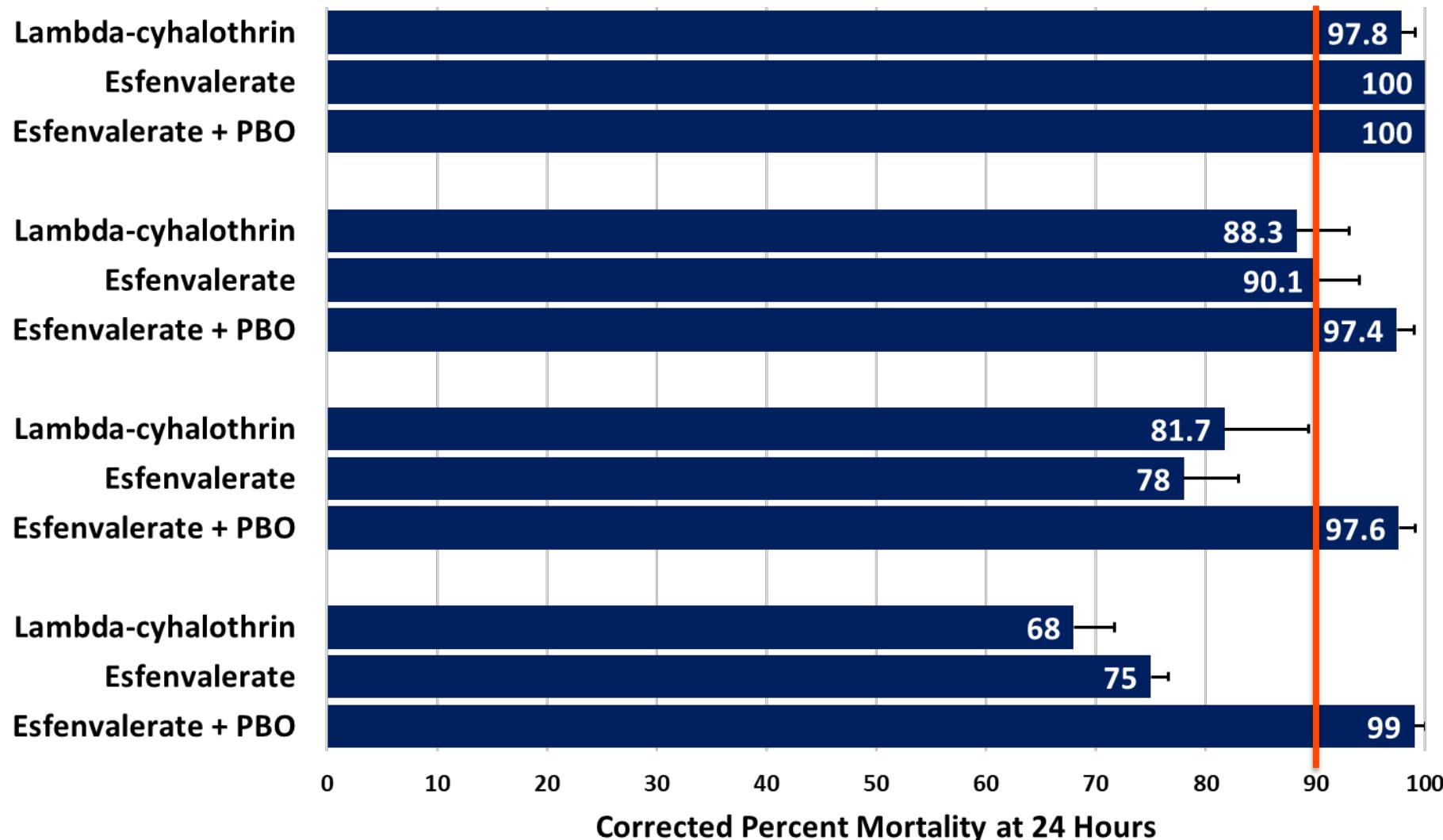


# Bioassay Experimental Design

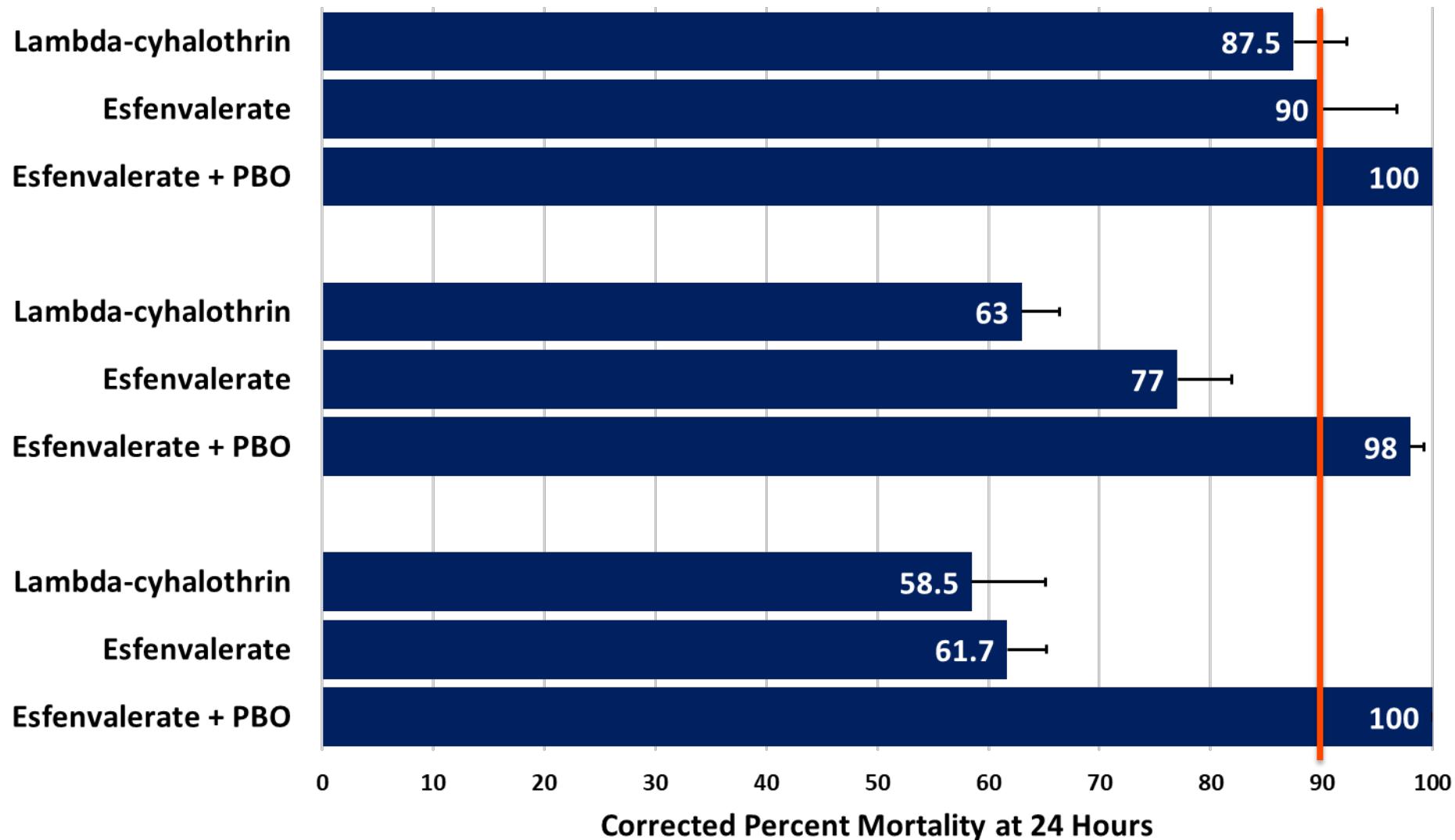
- RSSW adults collected at the onset of flowering
  - 28 locations in SD, 4 locations in ND in 2022
- 20 adults placed in vials 24 hr after collection
  - 5 vials per treatment
- Evaluated 24 hr after placed into vials



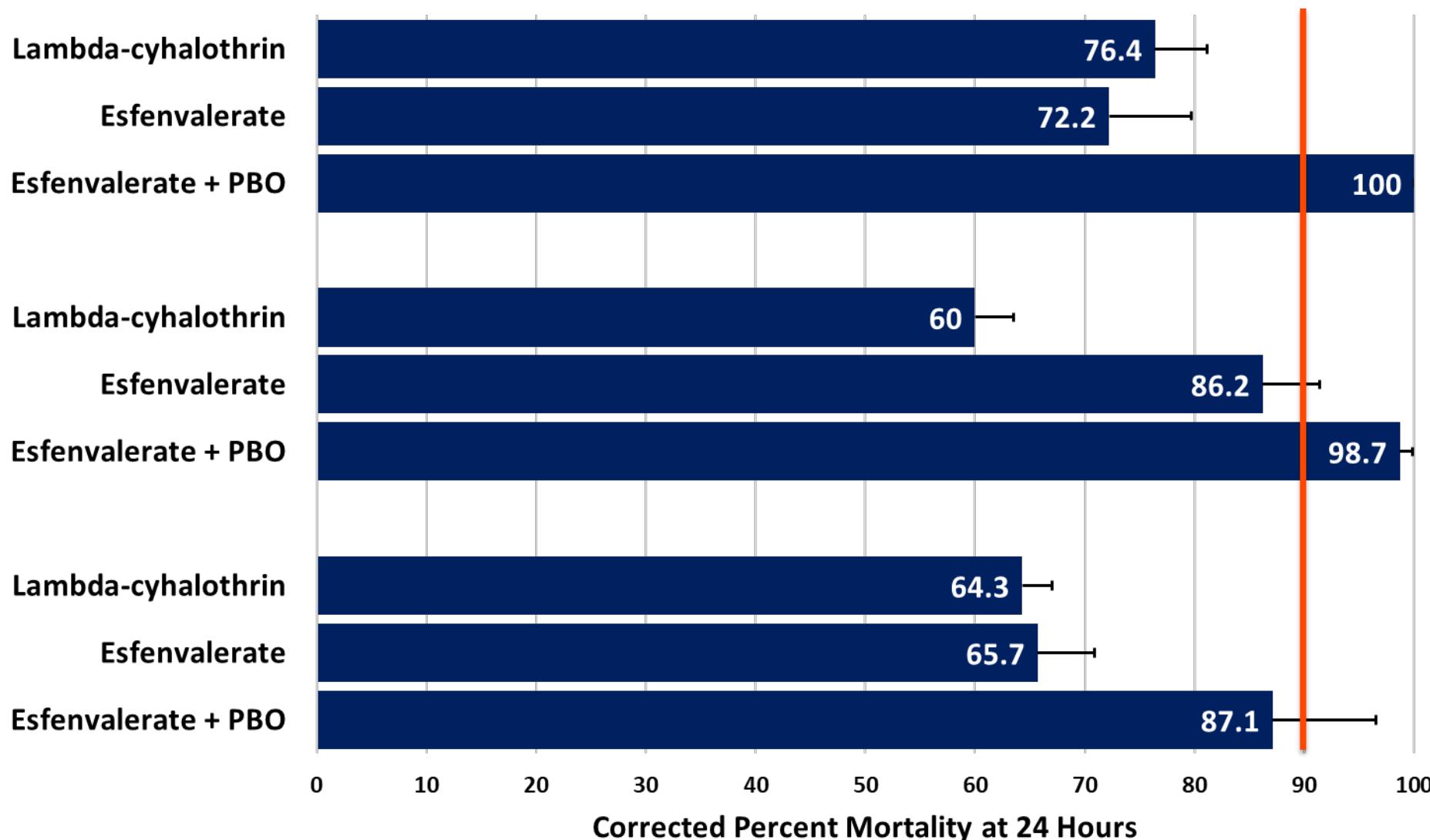
# Meade (top), Haakon, Pennington, Bennett (bottom)



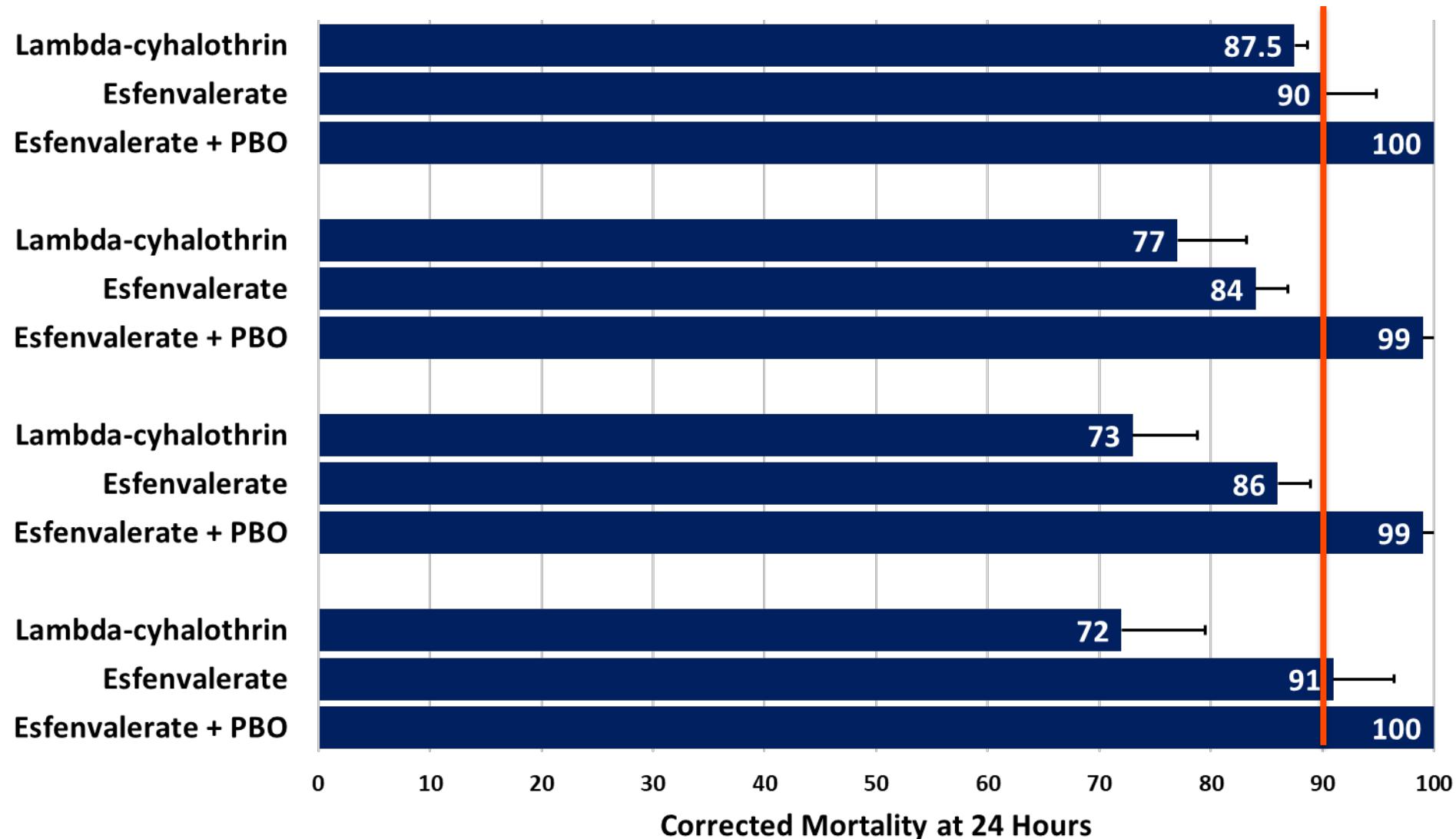
# Hyde (top), Buffalo, Lyman (bottom)



# Potter County

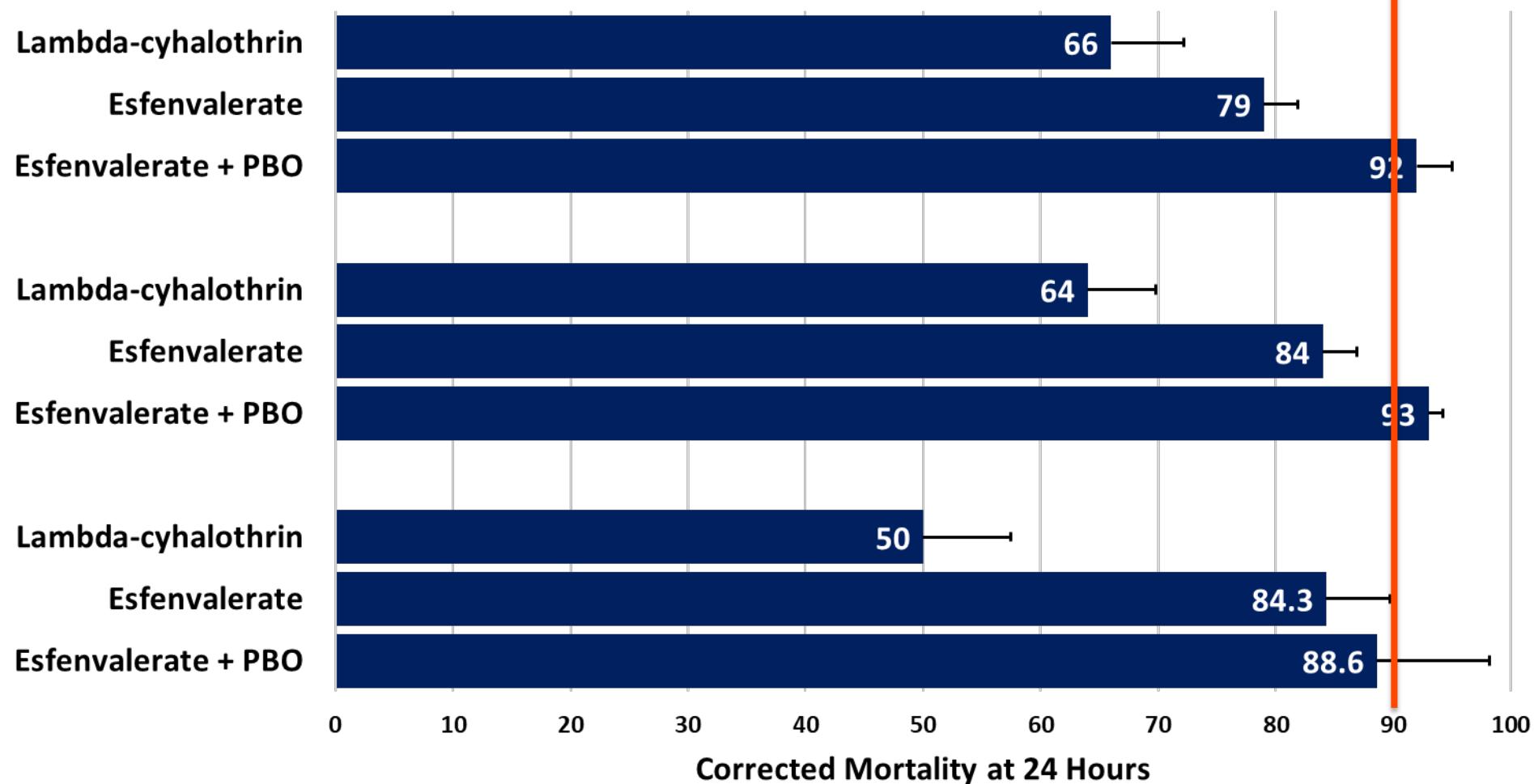


# Hughes County, 4 of 7 fields

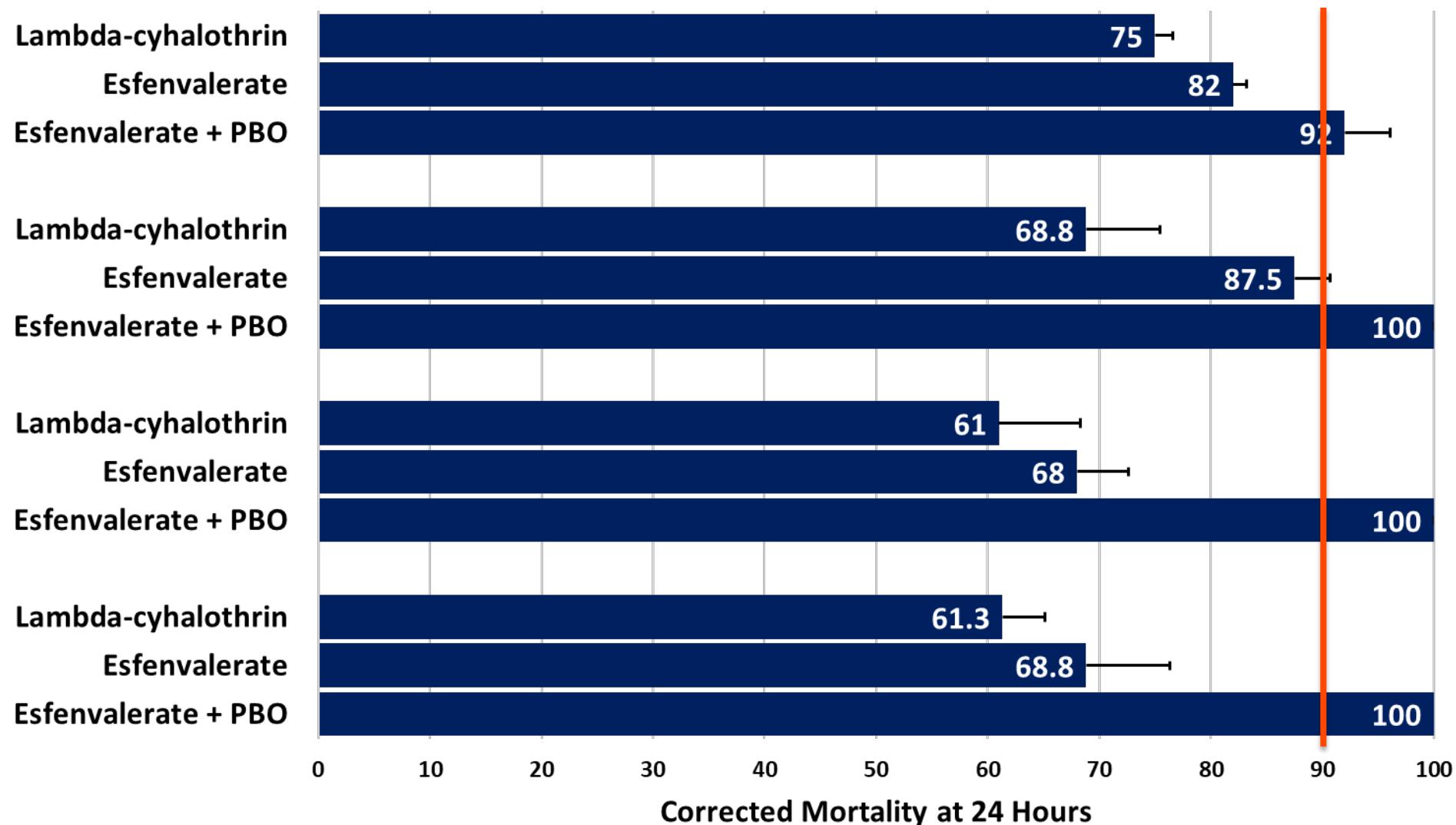


# Hughes County, 3 of 7 fields

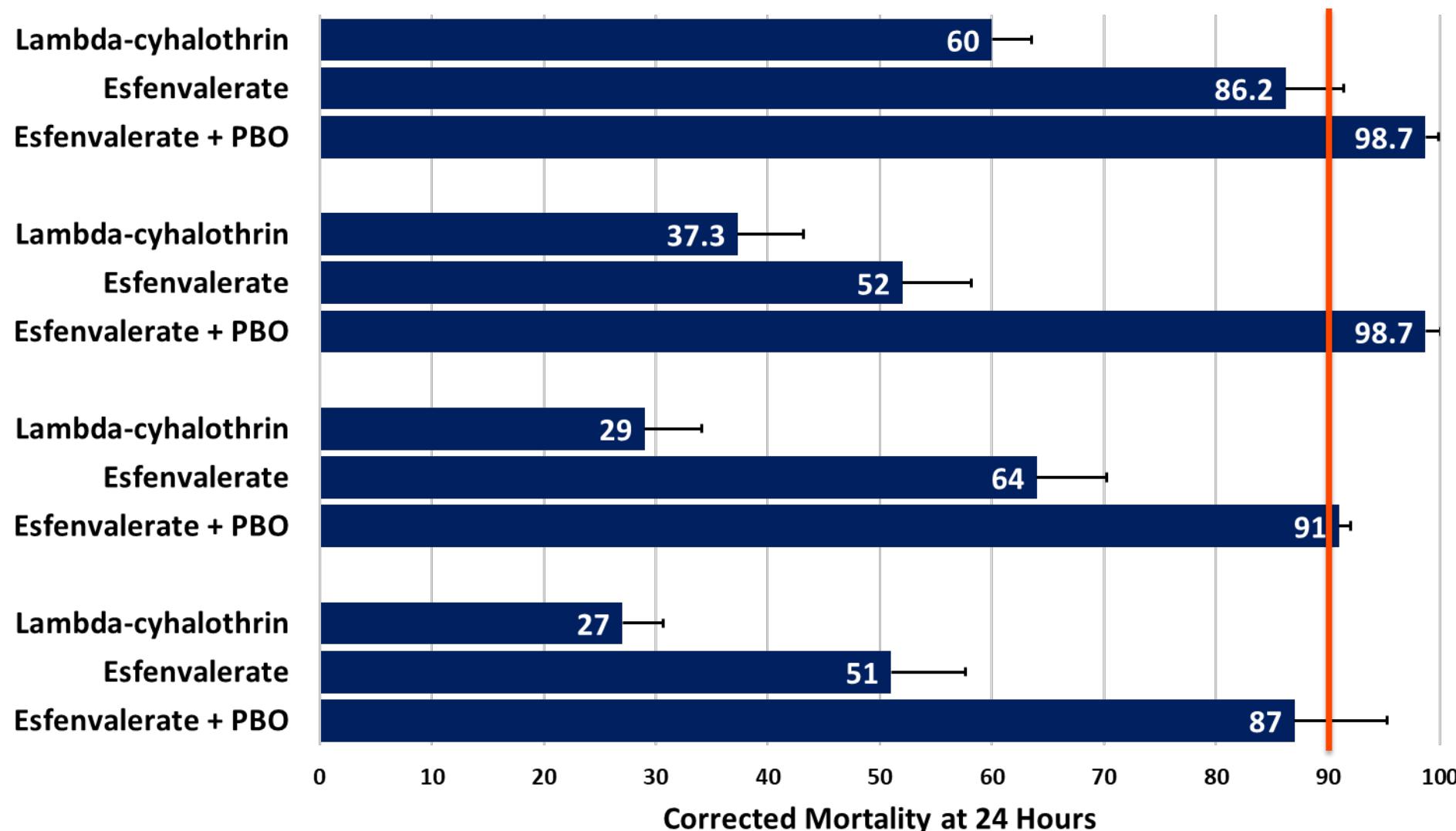
## Hughes County, 3 of 7 Fields



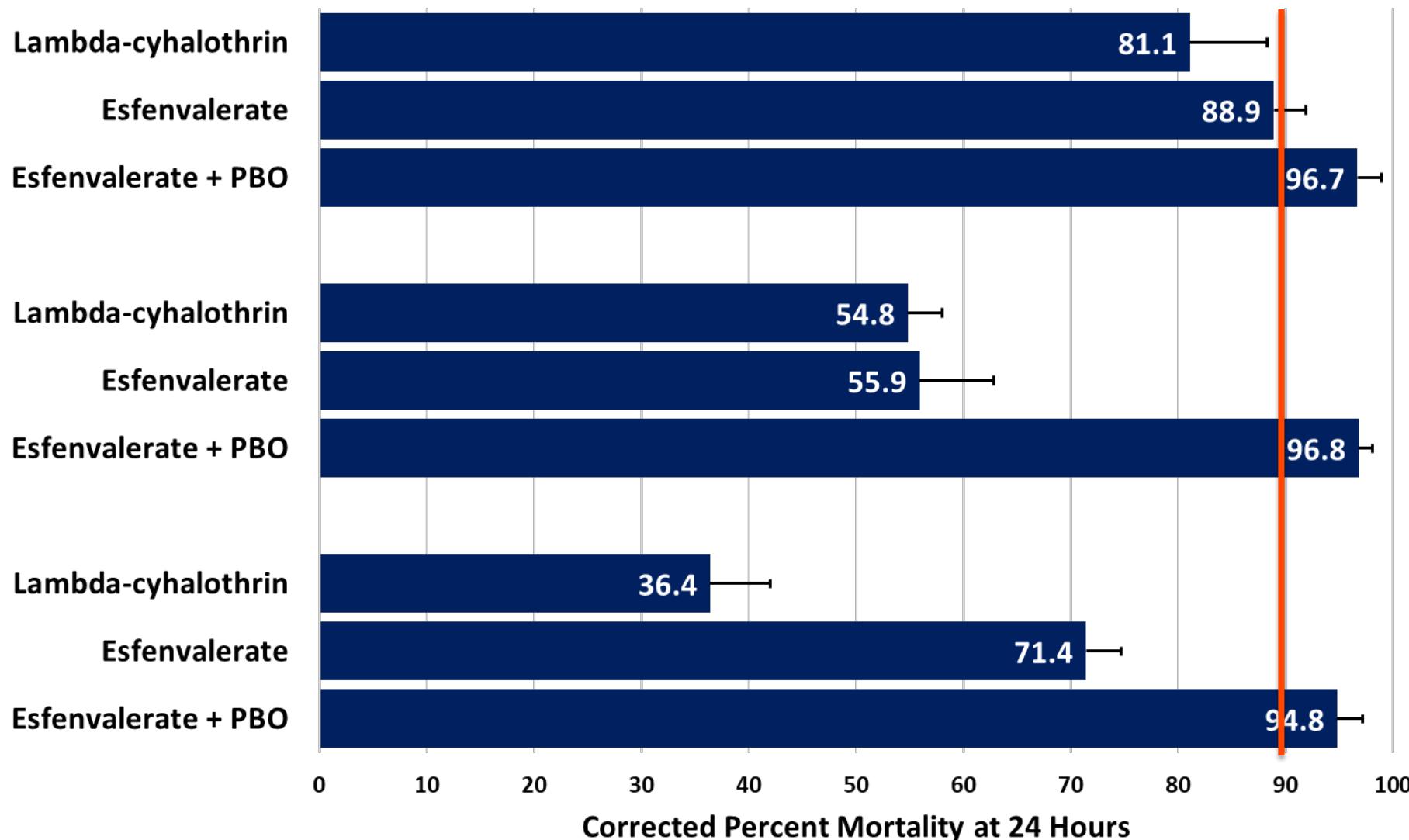
# Sully County, 4 of 8 Fields



# Sully County, 4 of 8 Fields



# Stanley County



# 2022 Conclusions

- Reduced susceptibility:
  - Lambda-cyhalothrin
  - Esfenvalerate
- Exponent increased mortality ~10-15% compared to Esfenvalerate alone
- Testing new chemistries not labeled in sunflower

# Dose Response Experimental Design

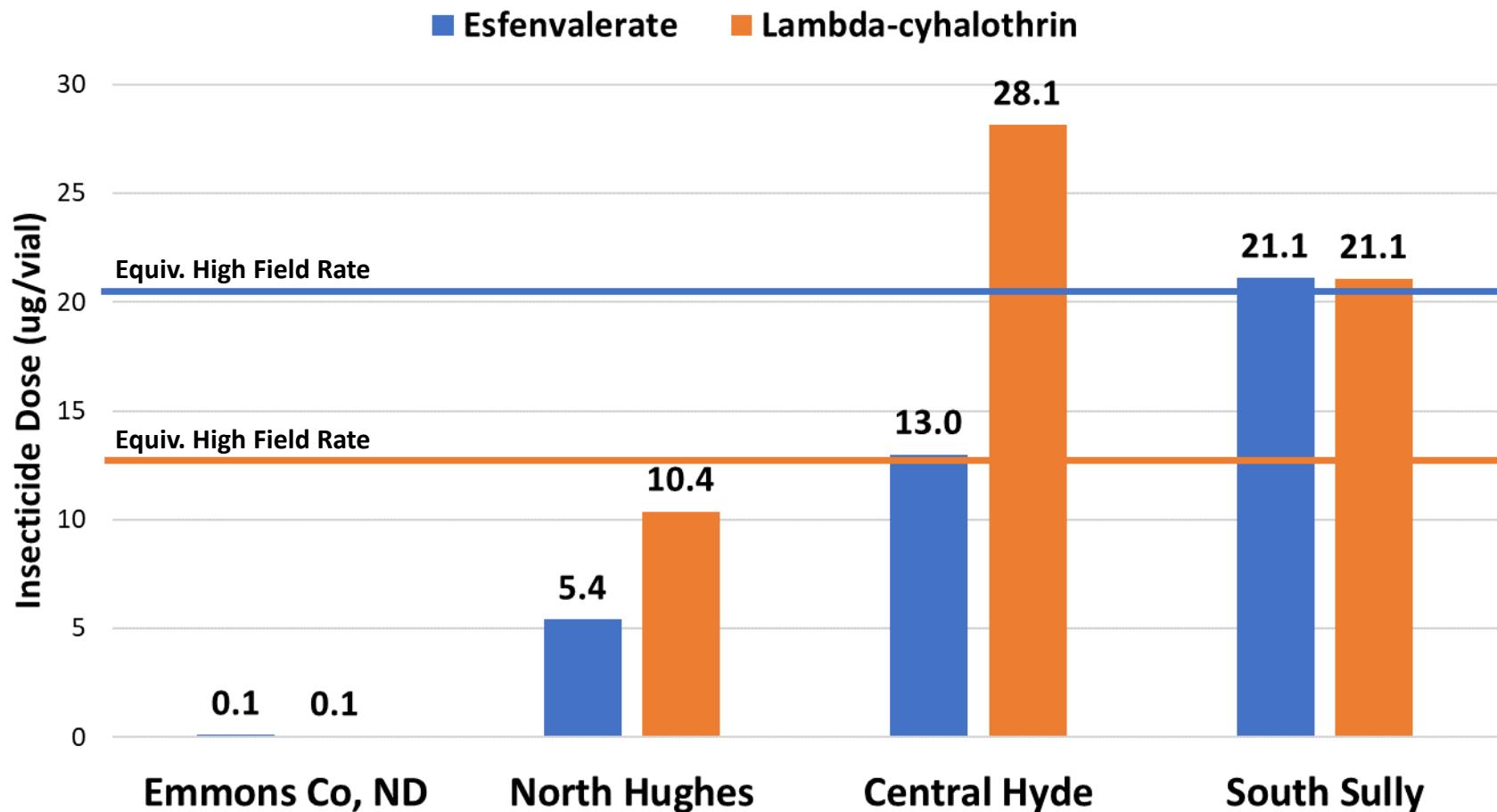
AI	Field Rate Equivalent	Dose/Vial
Esfenvalerate	0.125x	2.65
Esfenvalerate	0.25x	5.295
Esfenvalerate	0.5x	10.59
Esfenvalerate	1x	21.18
Esfenvalerate	2x	42.365
Esfenvalerate	4x	84.725
Lambda-cyhalothrin	0.125x	1.67
Lambda-cyhalothrin	0.25x	3.34
Lambda-cyhalothrin	0.5x	6.675
Lambda-cyhalothrin	1x	13.35
Lambda-cyhalothrin	2x	26.705
Lambda-cyhalothrin	4x	53.405

# Dose Response Experimental Design

- Experimental design same as for bioassay
- Measured mortality at 24 hours
- 3 fields in SD, 1 field in ND (considered susceptible population)
- Determined LD50, LD90 values for esfenvalerate and lambda-cyhalothrin for each field population
  - Probit analysis (PROC PROBIT, SAS 9.4)

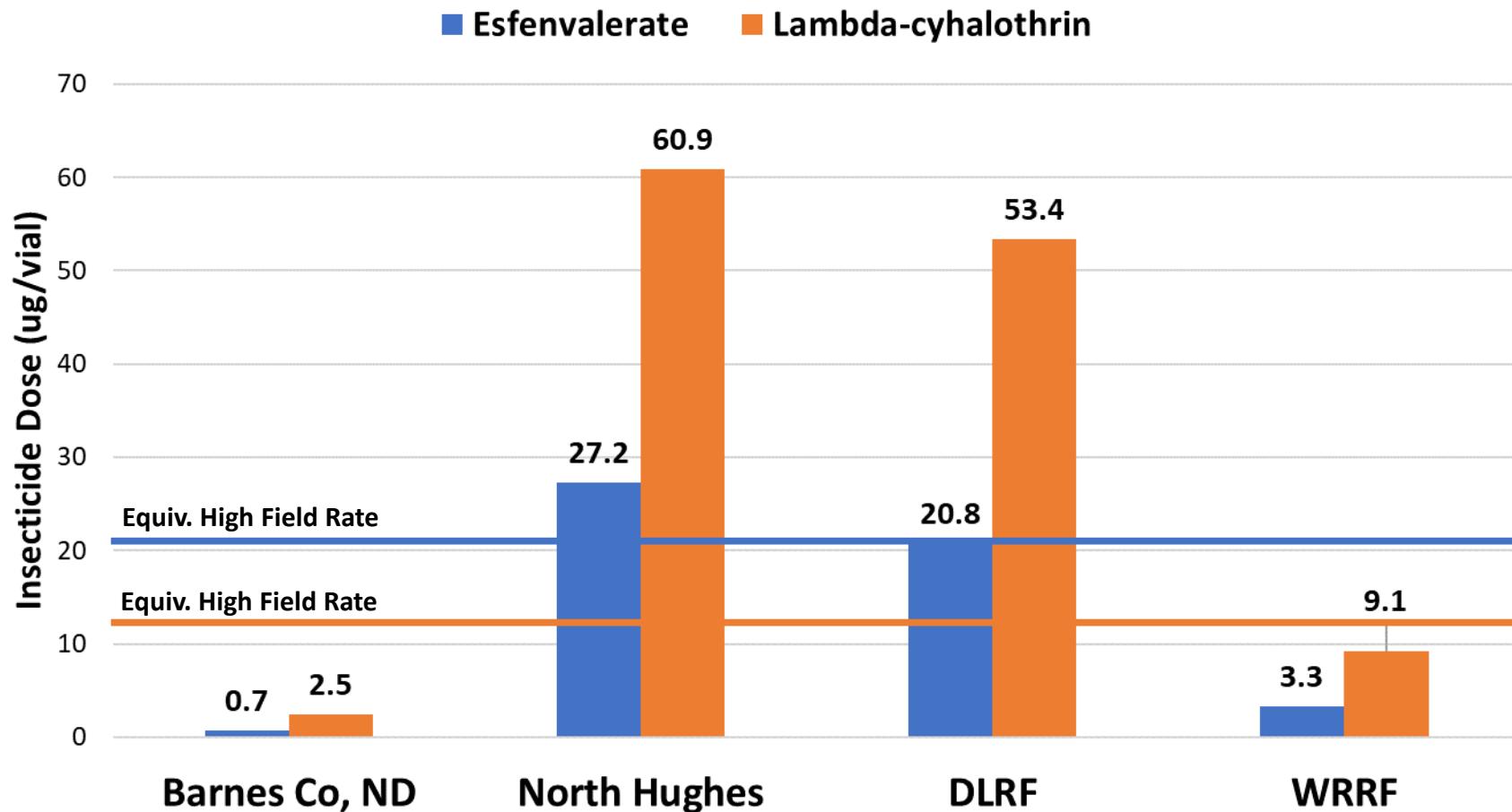
# Dose Response Results, 2021

## LD50 Values, 2021



# Dose Response Results, 2022

## LD50 Values, 2022

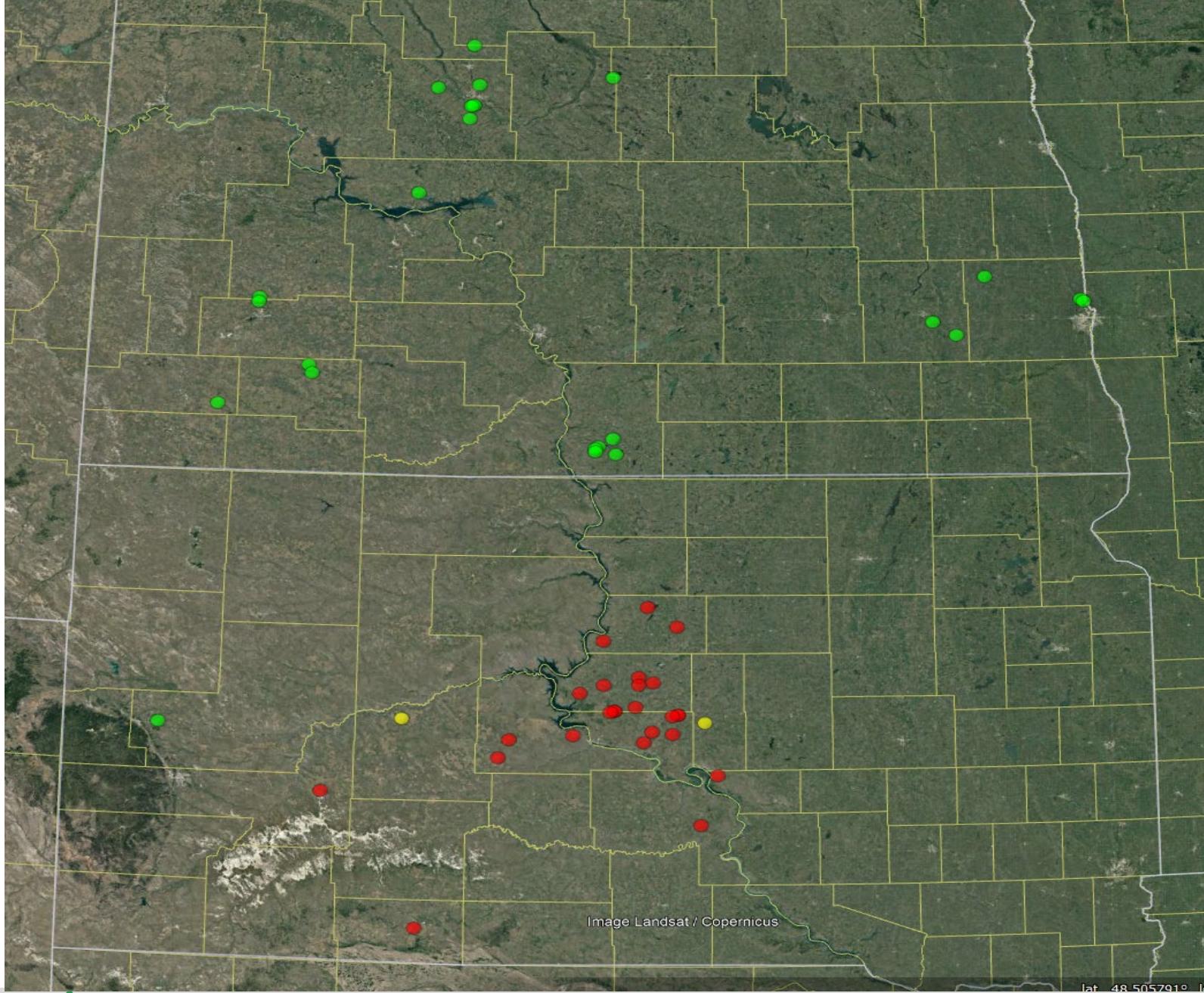


# Resistance Ratios

- Test population/Known susceptible population
- RR < 5: population is susceptible
- RR 5-10: population is moderately resistant
- RR > 10: population is highly resistant

# Resistance Ratios (LD<sub>50</sub>)

Year	Location	Chemical	Resistance Ratio
2021	Hughes Co.	Esfenvalerate	<b>26</b>
		Lambda-cyhalothrin	<b>81</b>
	Hyde Co.	Esfenvalerate	<b>56</b>
		Lambda-cyhalothrin	<b>229</b>
2022	Sully Co.	Esfenvalerate	<b>99</b>
		Lambda-cyhalothrin	<b>157</b>
	WRRF	Esfenvalerate	<b>5</b>
		Lambda-cyhalothrin	<b>4</b>
	DLRF	Esfenvalerate	<b>30</b>
		Lambda-cyhalothrin	<b>22</b>
	Hughes Co.	Esfenvalerate	<b>39</b>
		Lambda-cyhalothrin	<b>25</b>



# Conclusions

- Confirmed resistance in South Dakota to Esfenvalerate and Lambda-cyhalothrin
- RR's are higher for Lambda-cyhalothrin
- Continue to fight very large RSSW populations
- Emergence of RSSW and entry into fields
  - Many fields sprayed in 2022 before peak populations were present
- Routine treatment of RSSW with same a.i.'s

# Conclusions

- Synergist (Exponent) increased esfenvalerate mortality in lab, but how will it perform under high RSSW pressure?
- Need to continue field monitoring and dose response data to document evolving resistance in RSSW
- Need to expand dose range (higher) to capture higher LD values (e.g. LD90, LD99) in SD, lower doses to capture LD values for ND

# Acknowledgements

- Funding Sources:



**South Dakota Oilseeds Council**



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**SOUTH DAKOTA STATE  
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**Adam Varenhorst  
Assistant Professor and Extension Field Crop Entomologist**

**South Dakota State University  
308 Berg Agricultural Hall (SAG), SDSU  
Brookings, SD 57007**

**Office: 605.688.6854**

**Email: [adam.varenhorst@sdstate.edu](mailto:adam.varenhorst@sdstate.edu)**

**Twitter: [@SDSUExt\\_Insects](https://twitter.com/SDSUExt_Insects)**

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