

# Using Large Scale Datasets to Improve Tobacco Scouting Recommendations

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# Motivation

- IPM in tobacco shown to be more profitable than non-IPM (Slone & Burrack 2016)
- Average Tobacco Farm increased in size
  - 1982 – 10 acres
  - 2012 – 100 acres
- Capital constraints may reduce adherence to IPM practices

# Motivation

Insecticide applications and scouting inputs				Input cost (USD)		
Site	Year	GS	IPM	GS	IPM	Difference (GS-IPM)
1	2015	Belt (2x), Besiege, Warhawk	Belt, Scouting labor <sup>b</sup>	\$87.54	\$35.90	\$51.64
2 <sup>a</sup>	2015	Admire, Belt, Coragen, Orthene (2x), Sniper	Belt, Scouting labor	\$98.16	\$31.40	\$66.76
3	2015	Coragen, Orthene	Orthene, Scouting labor	\$59.15	\$24.70	\$34.45
4	2015	Belt, Orthene(2x)	Belt, Scouting labor	\$45.71	\$35.90	\$9.81
5	2015	Belt, Blackhawk	Belt, Blackhawk, Scouting labor	\$43.23	\$53.43	-\$10.20
6	2015	Belt, Orthene	Belt, Scouting labor	\$35.70	\$35.90	-\$0.20
7	2014	Belt (2x), Besiege, Warhawk	Belt, Scouting labor	\$87.54	\$35.90	\$51.64
8	2014	Coragen, Orthene, Warhawk	Belt, Scouting labor	\$78.30	\$35.90	\$42.40
9	2014	Belt, Orthene	Belt, Scouting labor	\$35.70	\$35.90	-\$0.20

<sup>a</sup> Site 2 did not receive greenhouse imidacloprid treatment, cost not included. Cost of greenhouse treatment included for all other sites.

<sup>b</sup> Scouting cost **\$10.20/acre** assuming \$12/hr wage. Pesticide application (IPM and GS) cost estimated at **\$4.19/acre/application** for labor and equipment use.

Average: \$27.34/acre

# Motivation

- IPM in tobacco shown to be more profitable than non-IPM (Slone & Burrack 2016)
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  - 1982 – 10 acres
  - 2016 – 144 acres
- Capital constraints may reduce adherence to IPM practices

# Motivation

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# Current Scouting Recommendations

Random walk through a field scouting 5 plants per stop

- Very Small Fields (1-3 acres): 8 Stops
- Small Fields (4-8 acres): 10 Stops
- Large Fields (> 8 acres): 10 stops + 2 stops for every 4 acres over 8 acres. 15 acre field = 14 stops

# Improving Scouting recommendations

## Ecoinformatics

- Large(ish) data sets
- Unique Analytical Tools
  - Artificial Intelligence
  - Machine Learning

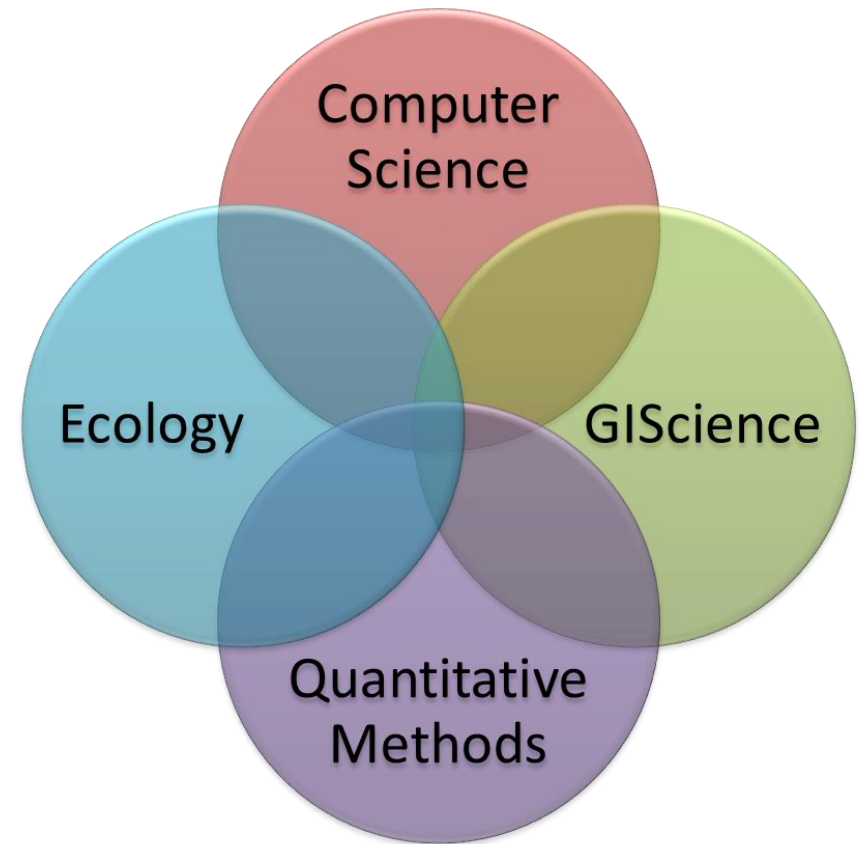
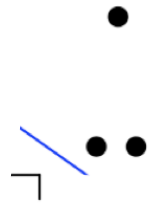
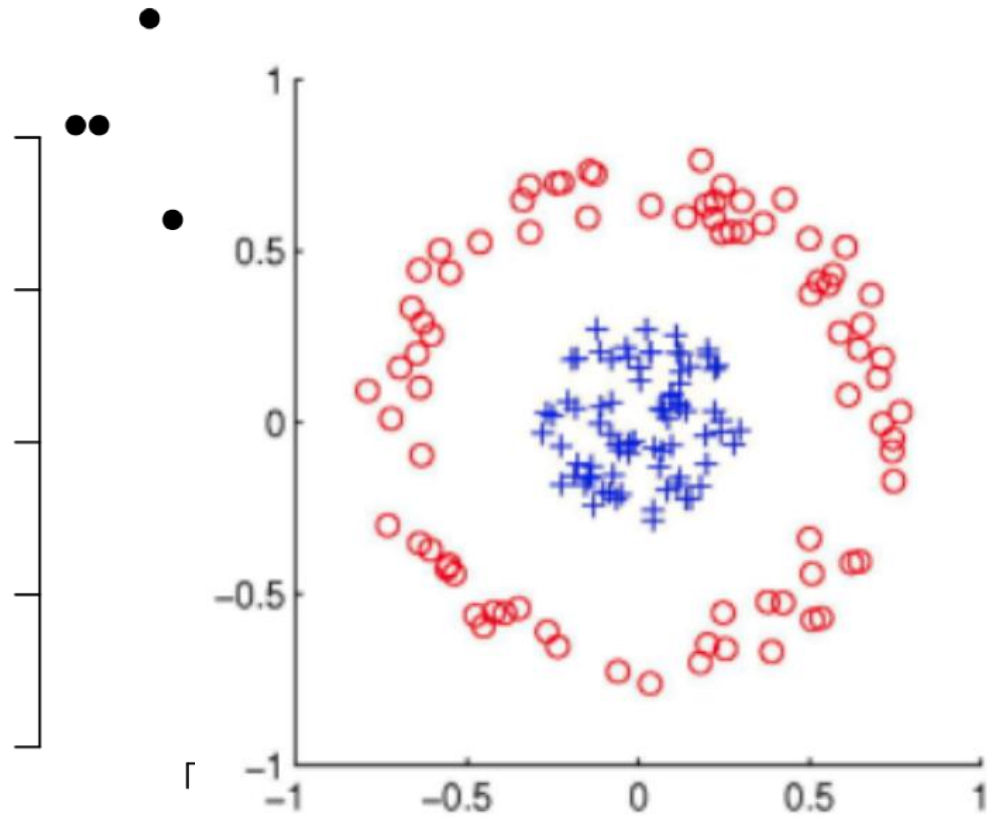


Figure 1. Ecoinformatics is an interdisciplinary study between Ecology, Computer Science, Geographic Information Science and Quantitative Models.

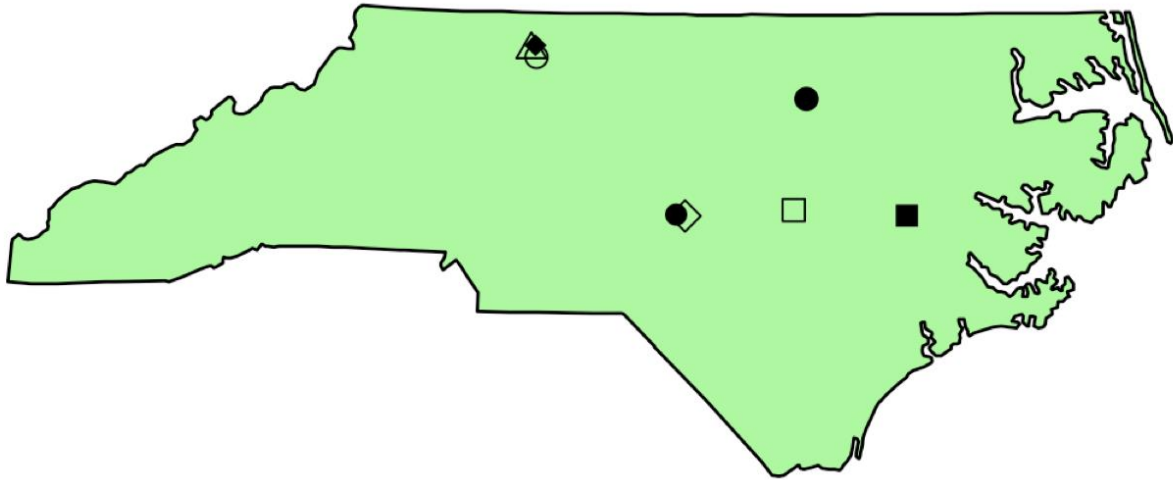
# Machine Learning





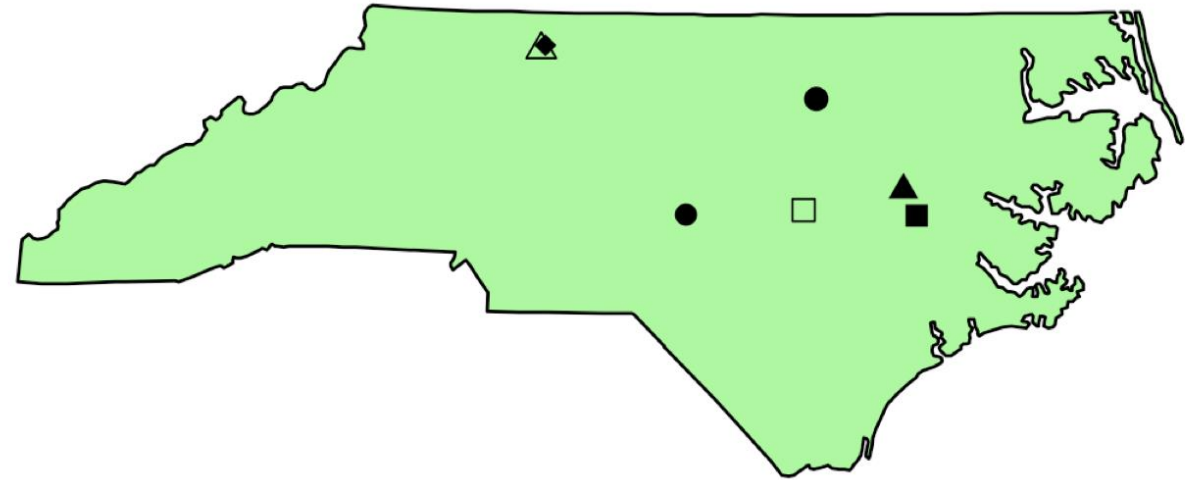
# Whole Farm Data Set

2017



8 Growers  
≈2100 acres

2018



7 Growers  
≈1700 acres

# Labor Inputs

- 7 miles walked per day (on average)
- 1200 miles driven per week
- 14000 Stops
- 70000 Plants scouted
- 1,400,000 Data points
- 2,000,000 insects observed
- Untold amounts of pens lost
- 12 times towed out of a field
- 1 time shot at







# Scouting Regiment

- Smallest field was 0.5 acre; Largest 160 acres
- Scouting Regime
  - Up to 5 acres: 10 stops, 50 plants
  - 5-10 acres: 20 stops, 100 plants
  - 10-15 acres: 30 stops, 150 plants
  - >15 acres: 40 stops, 200 plants



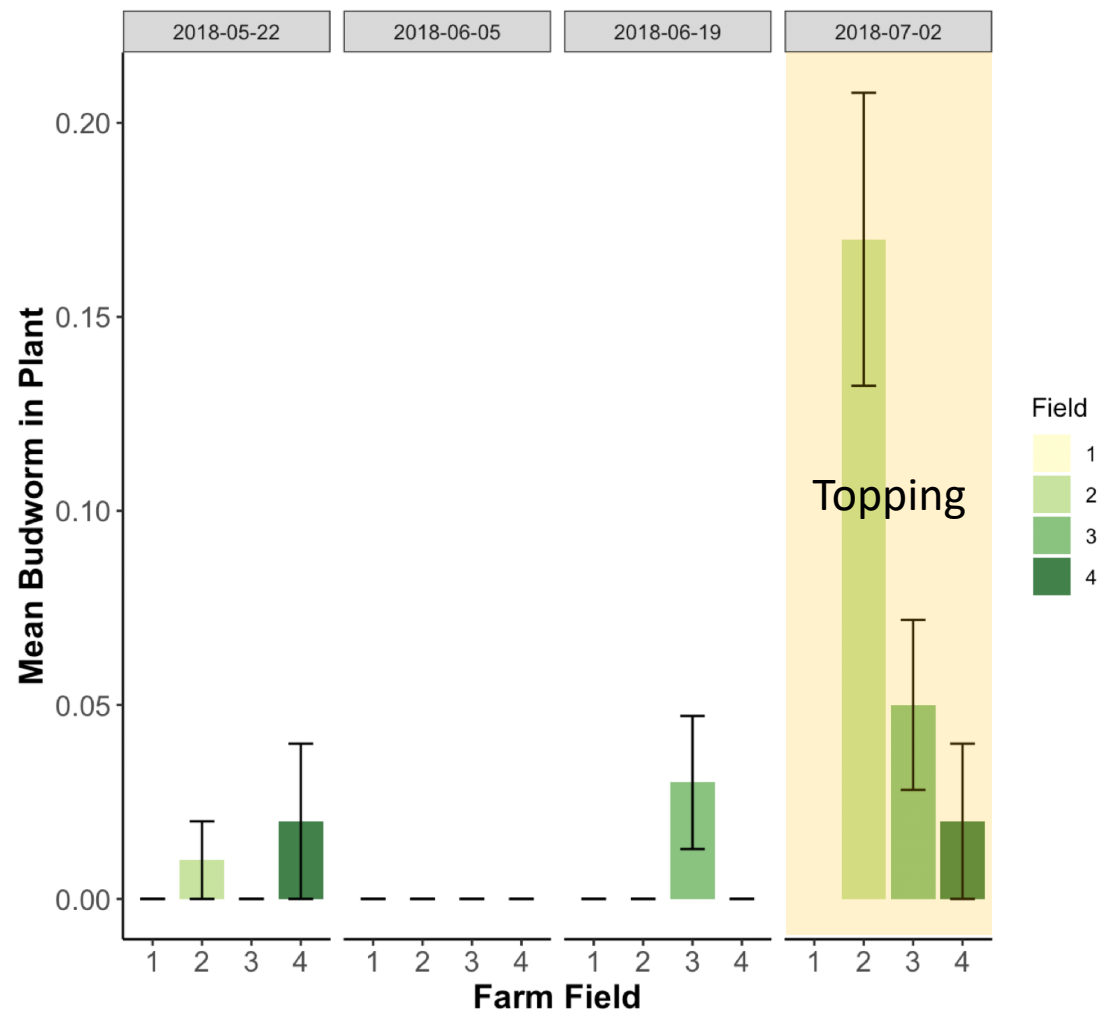
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Field	Tomato Spotted Wilt Virus	Aphids	Flea Beetles	Budworm	Hornworm
Stilt Bug	Big Eyed Bug	Spined Shouldered Stink Bug	Lady bug	Stink Bug	Japanese Beetle

Nelms 1 vs 2 vs 3 vs 4 (All Data)	SMO		MLP		J48	
	10-Fold	66% Split	10-Fold	66% Split	10-Fold	66% Split
Correct Classification						
Kappa Statistic						
AUROC						





**Budworm Management Action 5/22/2018**

Field	1	2	3	4
1	0			
2		0.01		
3			0	
4				0.02

**Budworm Management Action 6/6/2018**

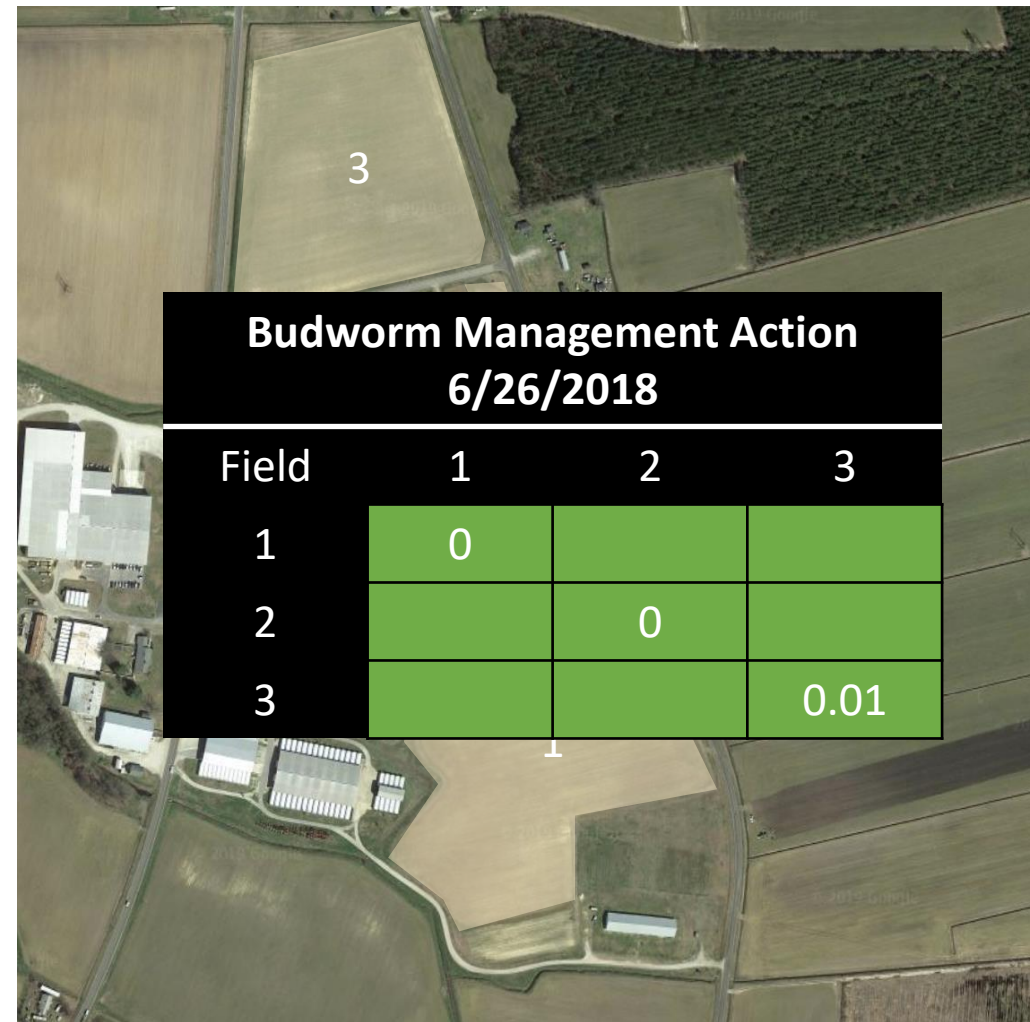
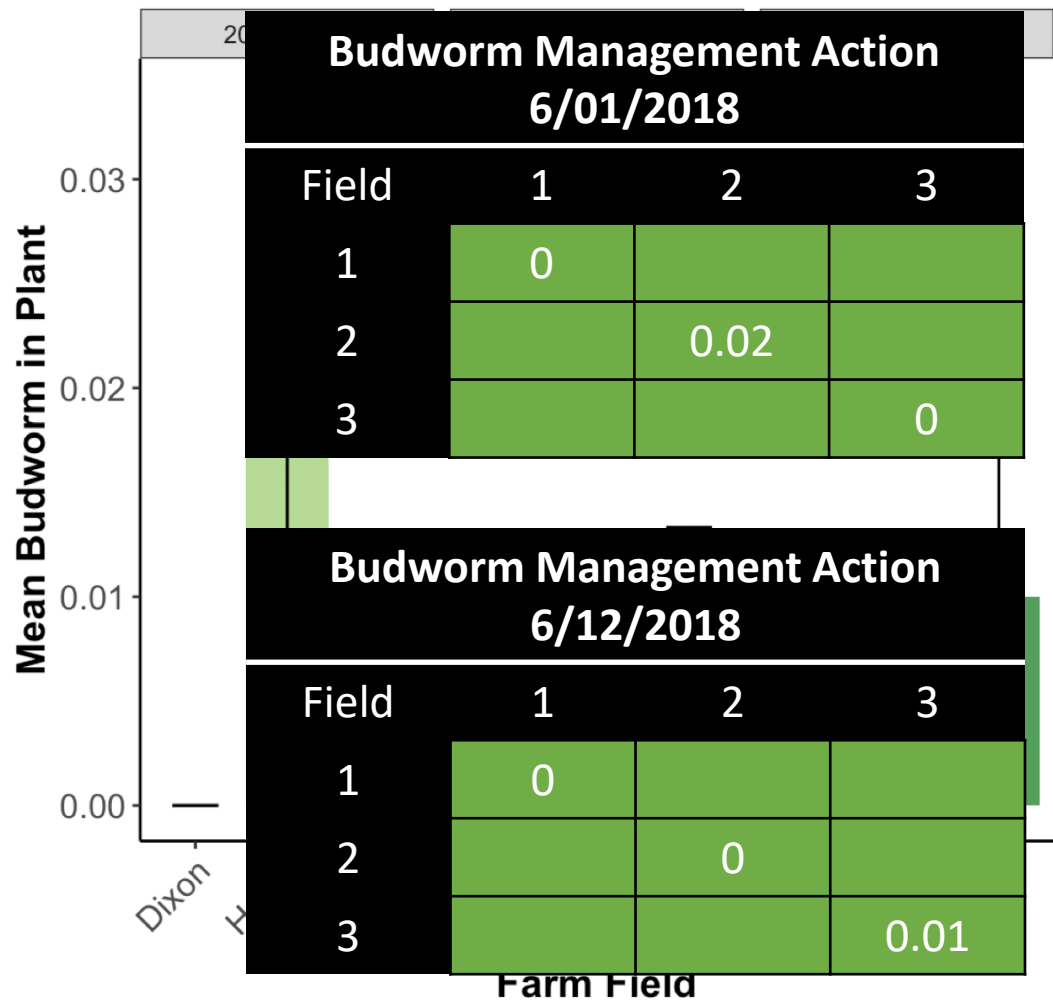
Field	1	2	3	4
1	0			
2		0		
3			0	
4				0

**Budworm Management Action 6/19/2018**

Field	1	2	3	4
1	0			
2		0		
3			0.03	
4				0

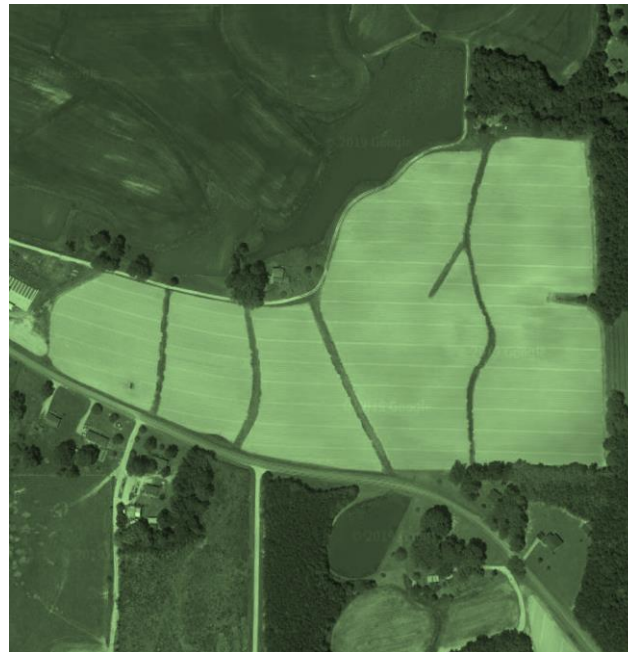
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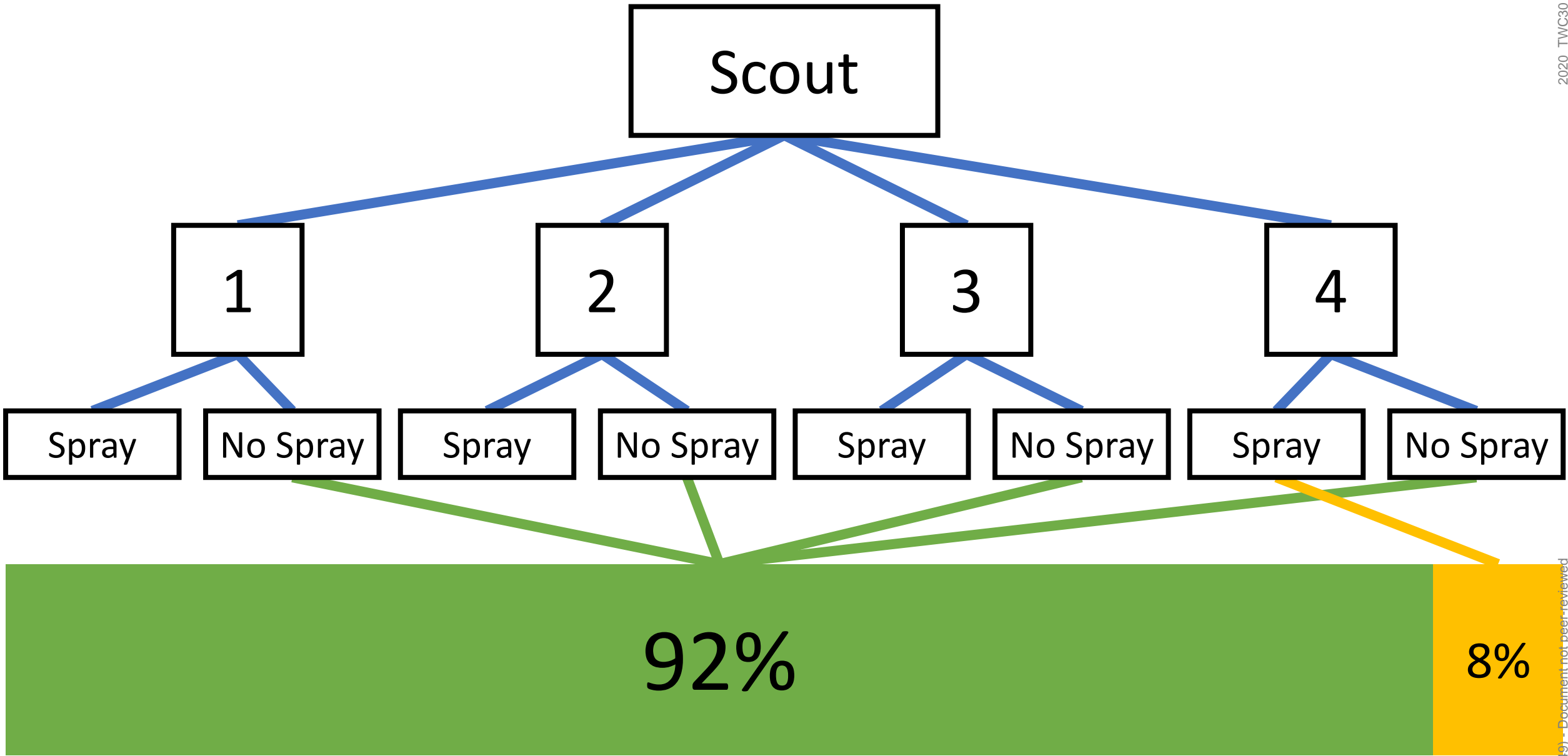
Below Threshold	Above Threshold
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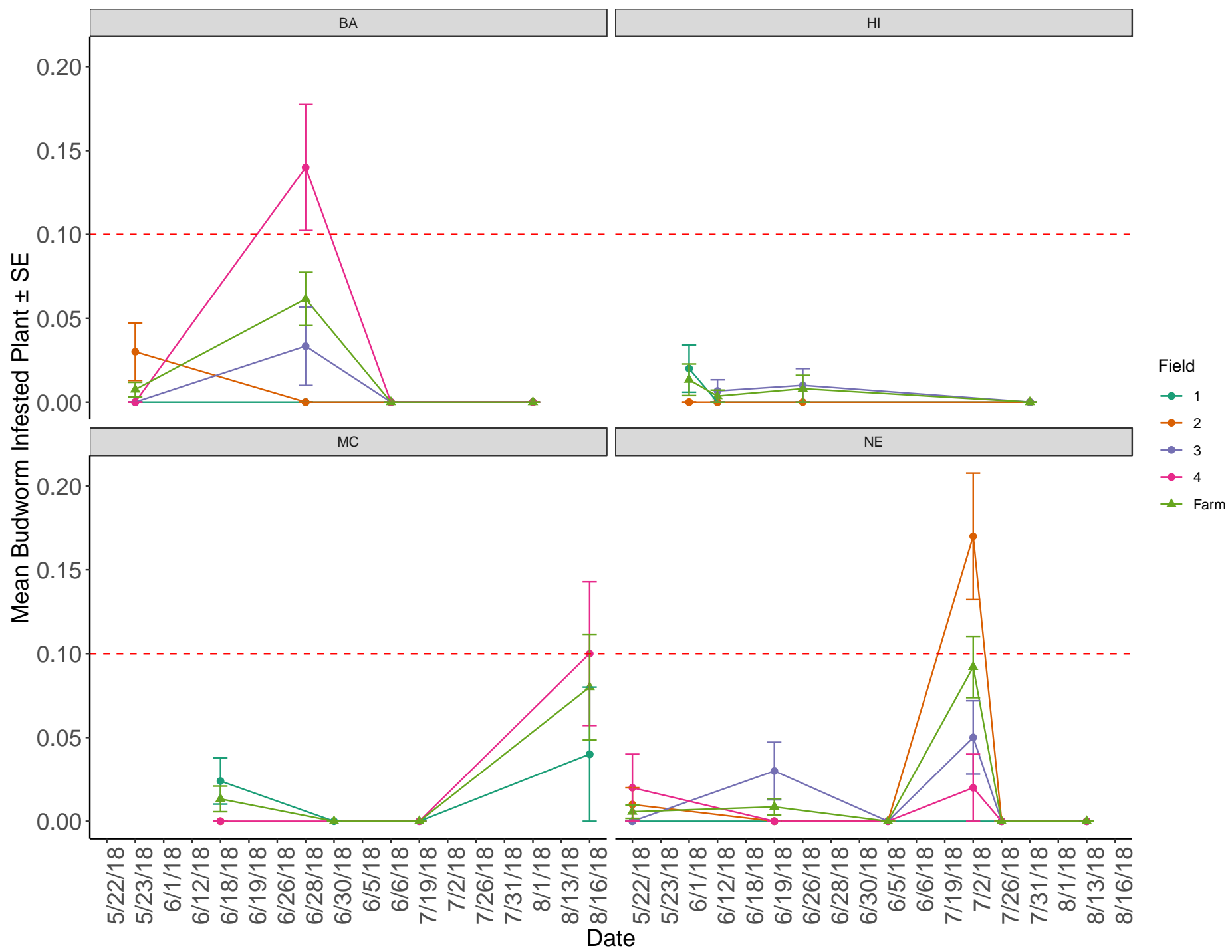


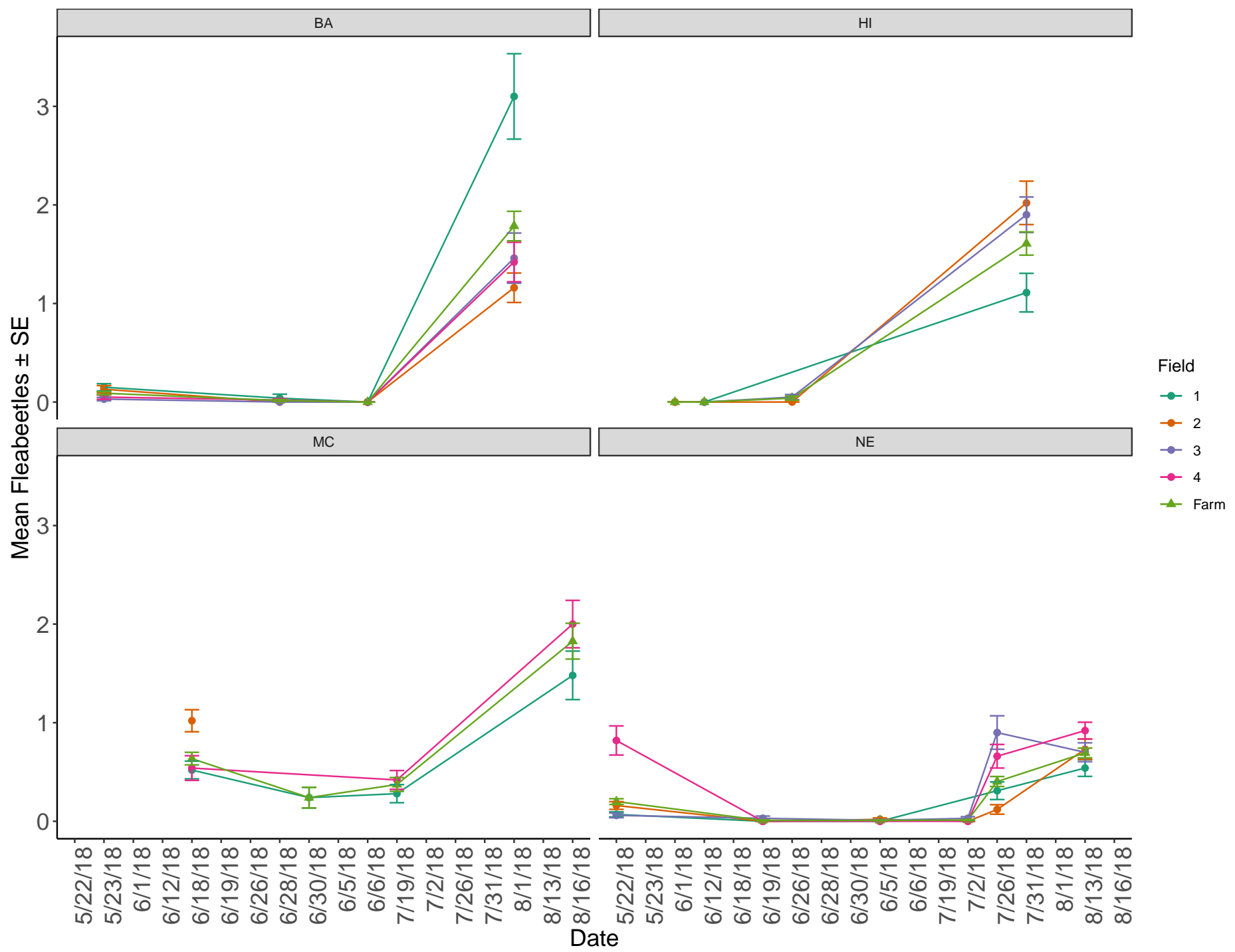
# Correct Calls

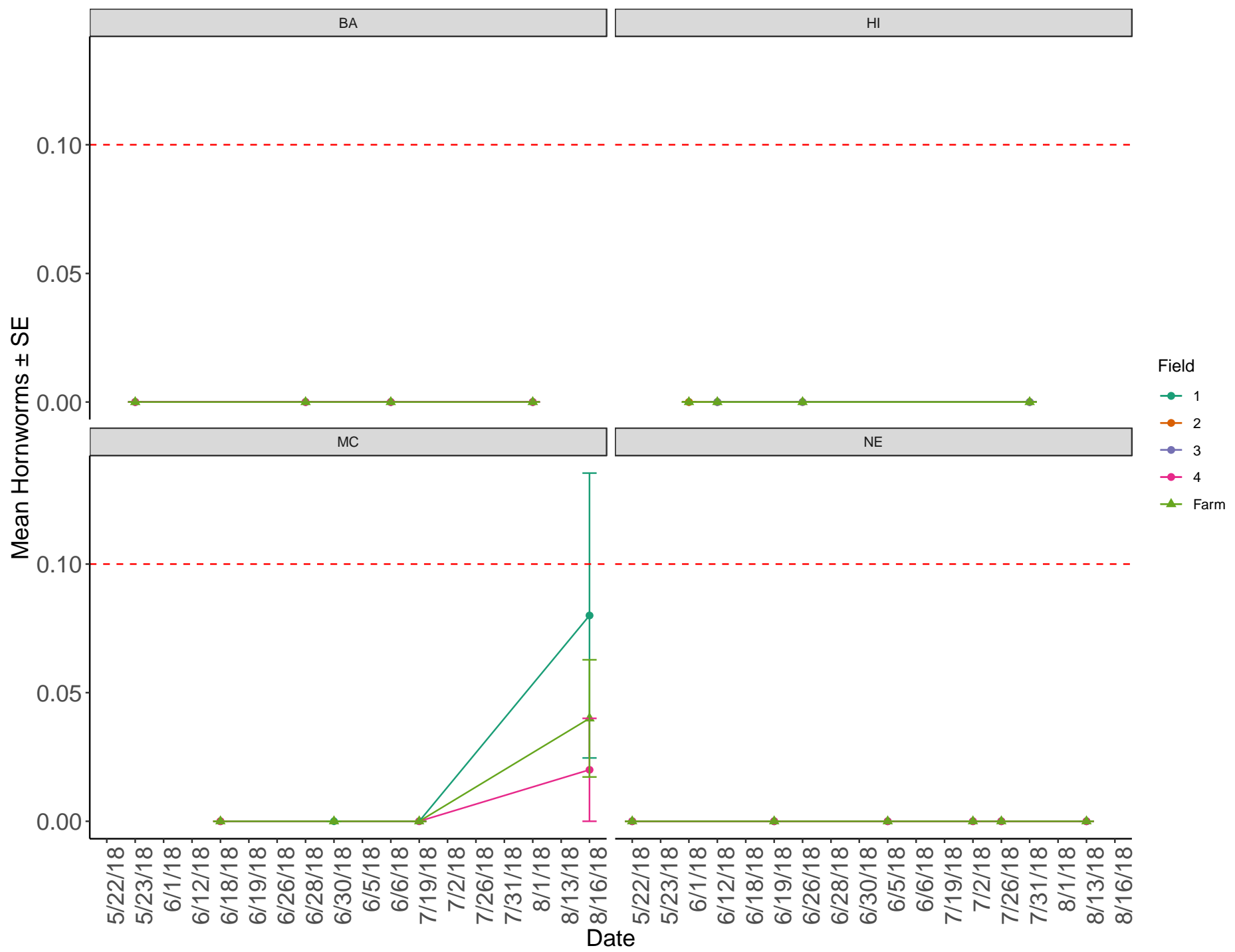
2018 Fields	
Correct	Incorrect
3	1
75%	25%







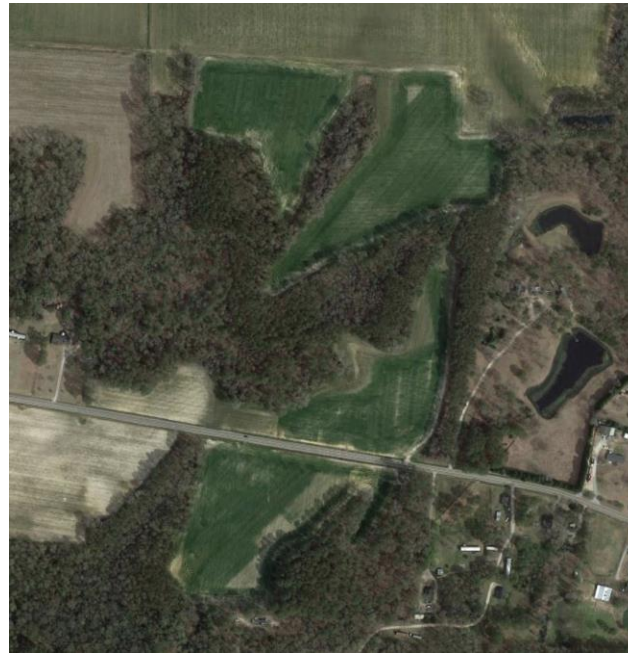






# Future Directions

- What conditions influence correct vs incorrect?
  - Pesticide use
  - Landscape
- Consequences of incorrect call?
  - Yield Loss
  - Unnecessary sprays
  - Increased labor



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