VFS Impact on Fate and Transport of a Fungicide

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Outline

- Introduction
- FUNG Transport - VFS Effectiveness
- FUNG Fate in Aquatic Environments within Landscapes w/ VFSs
- Summary

Introduction

- USEPA initial concerns:

- FUNG is persistent in terrestrial and aquatic environments.
- Potentially transported to off-site surface water via erosion.
- Potentially accumulated in aquatic systems over time, reaching or exceeding fish acute and chronic endpoints.

Introduction (cont.)

To continue to conclude that FUNG does not pose unreasonable adverse effects on the environment insofar as aquatic risks were concerned, two *conditions* centered on:

- *Determining the effectiveness of vegetative filter strips (VFS) to reduce runoff, sediment, and FUNG deliveries to off-site water bodies; and*

- *Conducting a controlled water monitoring study to better understand the environmental fate of FUNG in aquatic environments* (i.e. farm ponds w/ 15-ft VFS).

Introduction (cont.)

Based on dialogue between USEPA and Syngenta regarding the two conditions, USEPA and Syngenta agreed on the following objectives:

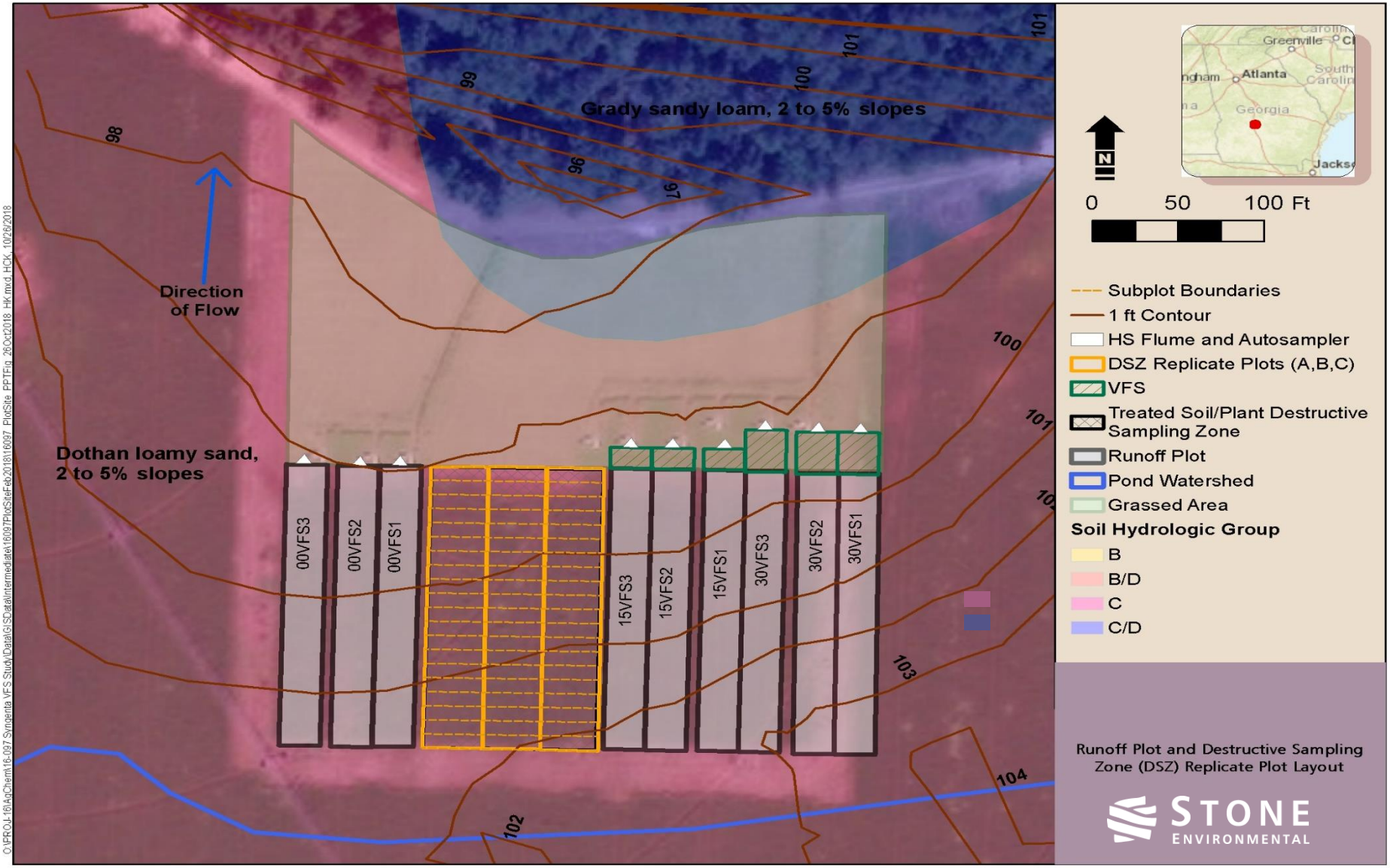
- *Quantify runoff, sediment and FUNG losses exiting 0-, 15-, & 30-ft VFSs from Southeastern (GA) and Midwestern (MO) landscapes under natural rainfall and maximum label seasonal rate of FUNG (solo formulation); and*

- *Evaluate FUNG fate and transport from the application site, through a 15-ft VFS, and into and from a farm pond under natural rainfall and maximum label seasonal rate of FUNG*.

VFS Effectiveness - Objective

Quantify runoff, sediment and FUNG losses exiting 0-, 15-, & 30-ft VFSs from Southeastern (GA) and Midwestern (MO) landscapes under natural rainfall and maximum label rate of FUNG (solo formulation).

VFS Effectiveness – Methods (GA Runoff Site)



VFS Effectiveness – Methods (GA Runoff Site)

- Treated Plot Size: 20’ X 200’ per replicate (3 reps/trt), Slope: 1–1.5%.
- 2018: Peanuts; 3 Apps @ ~14-d intervals

  2018 Total load – 0.204 lb ai/A (228 g ai/ha)

- 2019: Watermelons; 4 Apps @ ~ 14-d intervals

  2019 Total load – 0.272 lb ai/A (304 g ai/ha)

VFS Effectiveness – Methods (MO Runoff Site)

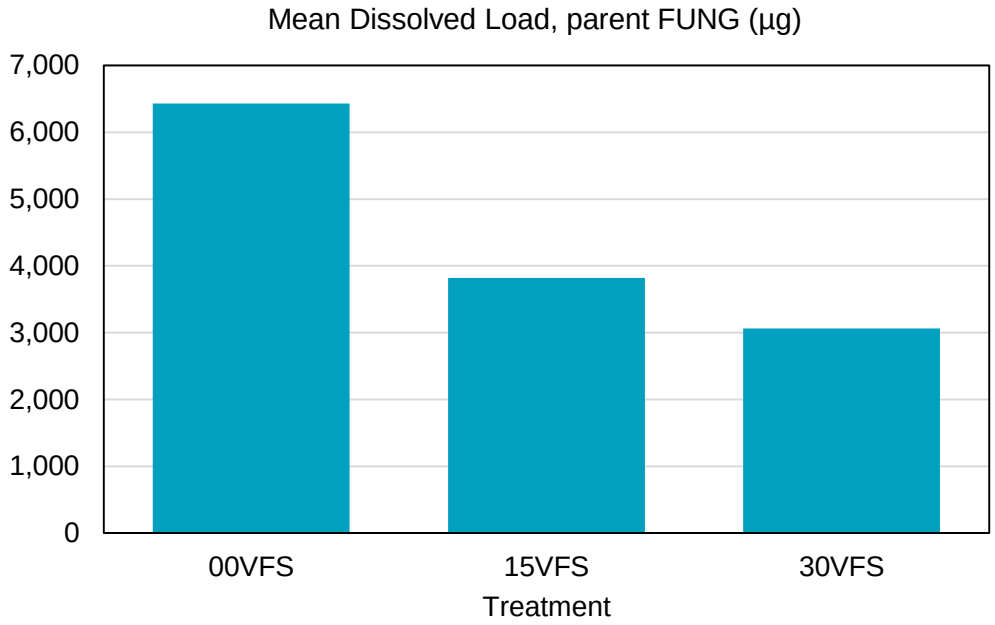
VFS Effectiveness – Methods (MO Runoff Site)

	2017	2018	2019
Crop	Corn	Soybeans	Soybeans
# Apps	2	2	2
	~14-day interval Annual load: 0.092 lb ai/A (104 g ai/ha)		

Slope: 3-4.5%.

VFS Effectiveness - Results (GA Runoff Site)

- Variability observed among plots (9) & treatments (3).
- No statistical difference in dissolved FUNG load among VFS treatments; however, FUNG loads numerically decreased with increasing VFS width.
- Runoff samples contained parent FUNG and three degradates.



VFS Effectiveness (Summary)

- FUNG applied to field sites in GA (2 yrs) & MO (3 yrs) to multiple crops at maximum label rates.
- Variability observed among plots (9) & treatments (3) at both sites.
- Runoff samples contained parent FUNG and three degradates – indicative of degradation occurring in terrestrial environment.
- No statistical difference in dissolved FUNG parent load among VFS treatments found at either site.
- However, for both sites dissolved FUNG loads numerically decreased with increasing VFS width.

Fate in Aquatic Environments - Objective

Evaluate FUNG fate and transport from the application site, through a 15-ft VFS, and into and from a farm pond under natural rainfall and maximum label seasonal rate of FUNG (solo formulation).

Fate in Aquatic Environments - Methods

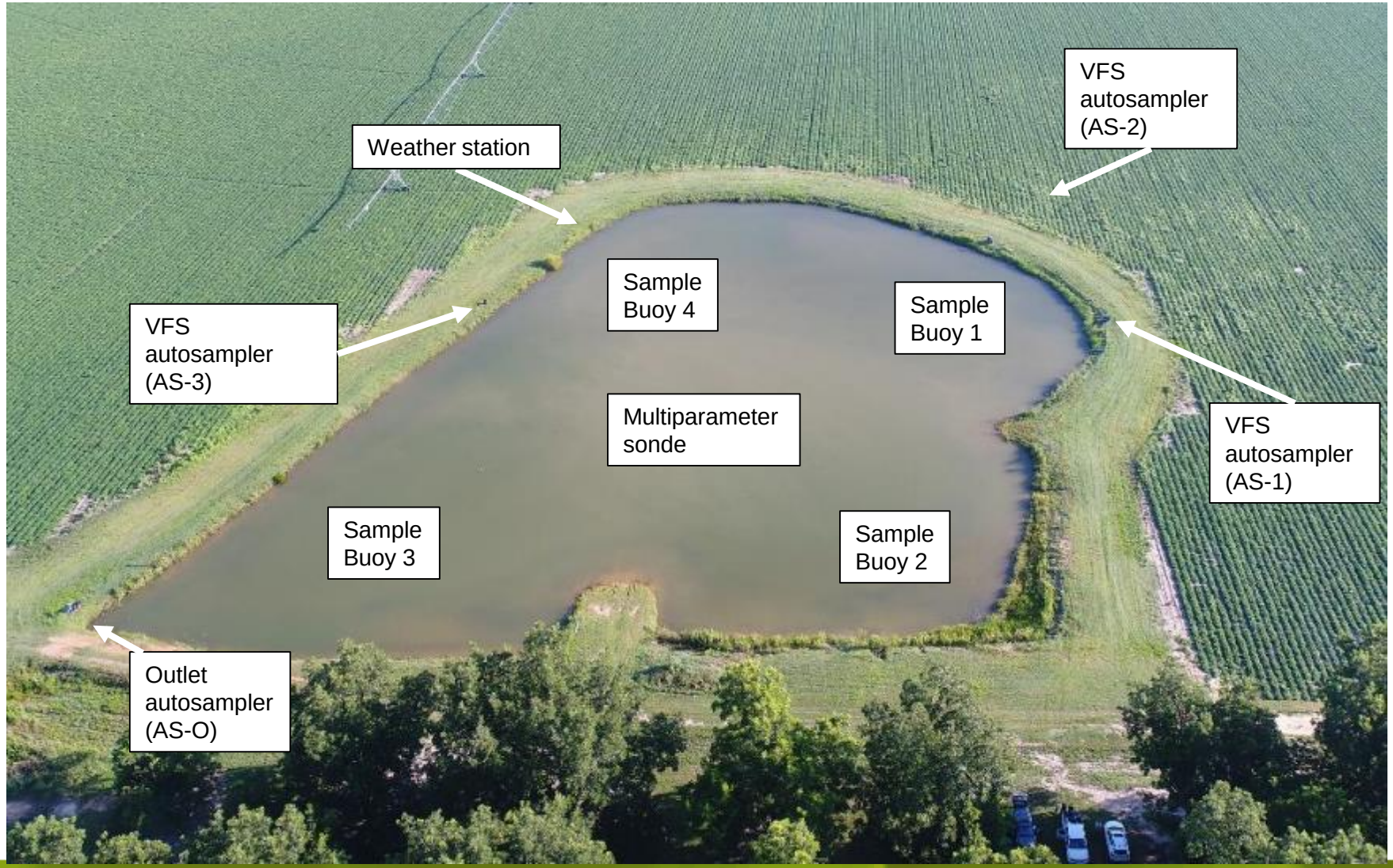
GA pond site

- ~15 ft VFS surrounding pond (varied depending on cropping practice).
- Crop treated area:pond ratio: ~9.9:1 (~21.8 acres: ~2.2 acres).
- HydroGrp C/D Soils (Dothan & Grady series).
- Slope within catchment : 1-3%

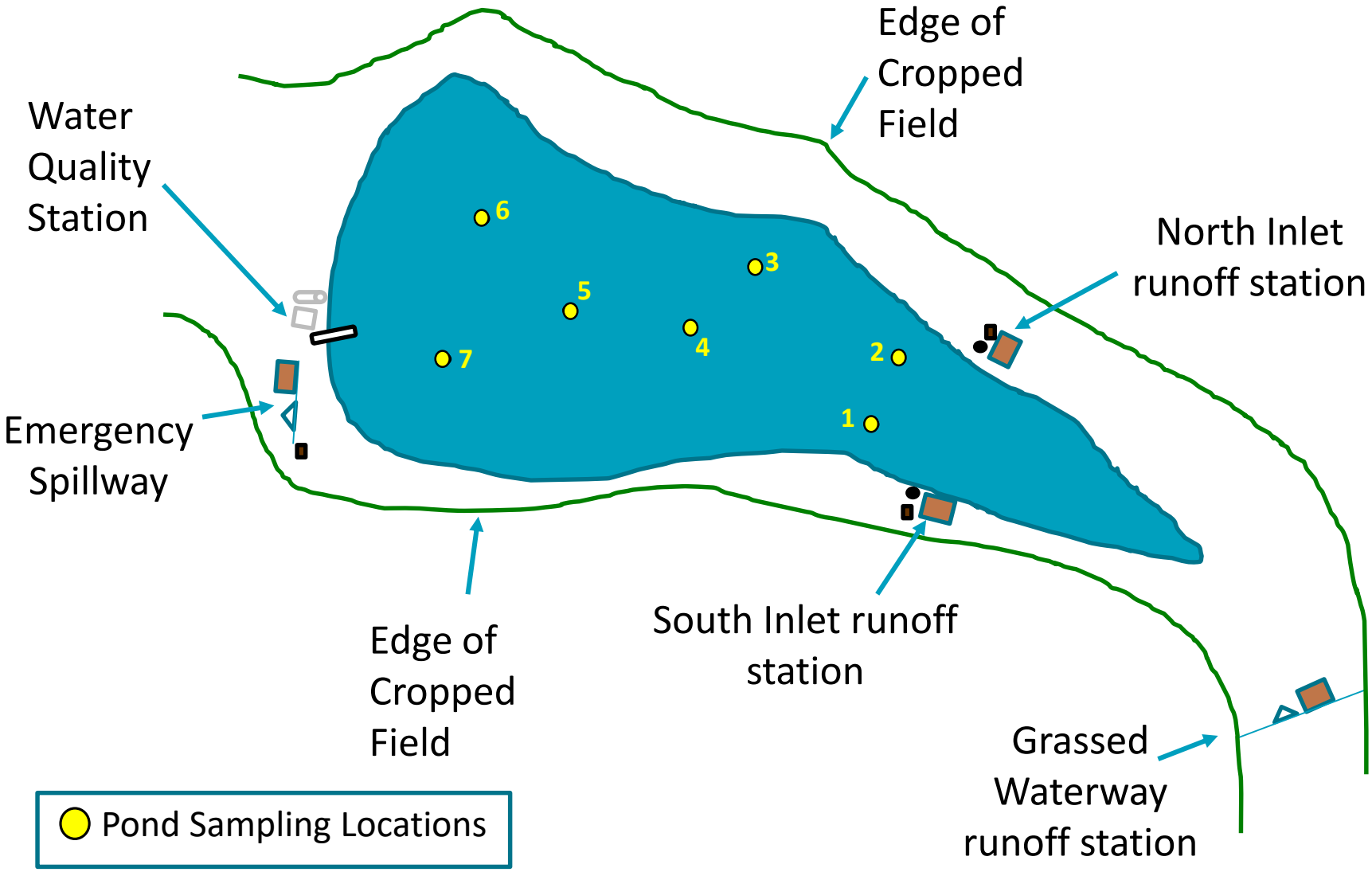
MO pond site

- VFS width ~15 ft; varied depending on pond water level and ability of grower to access areas near pond edge.
- Crop treated area:pond ratio: ~19:1 (~26.5 acres: ~1.4 acres).
- HydroGrp D Soils (New Mexico & Leonard series).
- Slope within catchment: 1-5%

Fate in Aquatic Environments – Methods (GA pond site)



Fate in Aquatic Environments – Methods (MO pond site)



Fate in Aquatic Environments - Methods

GA Pond Site			
Crop	**2017 - Cotton**	**2018 - Peanuts**	**2019 - Watermelon**
# Apps	2	3	4
Annual Load	0.136 lb ai/A (152 g ai/ha)	0.204 lb ai/A (228 g ai/ha)	0.272 lb ai/A (304 g ai/ha)
MO Pond Site			
Crop	**2017 - Corn**	**2018 - Soybeans**	**2019 - Soybeans**
# Apps	2	2	2
Annual Load	0.092 lb ai/A, (104 g ai/ha)	0.092 lb ai/A, (104 g ai/ha)	0.092 lb ai/A, (104 g ai/ha)

Fate in Aquatic Environments - Methods

Location	Crop	Date Range	Water Inputs[1] (in)	Runoff Events
Georgia	Cotton	(7/2017 – 5/2018)	34	10
	Peanuts	(5/2018 – 4/2019)	32	32
	Watermelons	(4/2019 – 11/2019)	33	7
Missouri	Corn	(7/2017 - 6/2018)	21	22
	Soybeans	(6/2018 - 8/2019)	66	67
	Soybeans	(8/2019 -11/2019)	15	15

[1] Water inputs = rainfall + irrigation for Georgia, precipitation only for Missouri (no irrigation at the MO site)

Fate in Aquatic Environments - Results
Edge-of-Pond Runoff Samples

Georgia

Results from 44 event-based composite edge-of-pond runoff samples

Summary of ≥ LOQ (0.05 ppb) detections in runoff samples:

- Parent: 76 samples
- Deg 1: 61 samples
- Deg 2: 33 samples
- Deg 3: 6 samples (>LOD[1], trace)

Missouri

Results from 228 composite edge-of-pond runoff samples

Summary of ≥ LOQ (0.05 ppb) detections in runoff samples:

- Parent: 204 samples
- Deg 1: 191 samples
- Deg 2: 135 samples
- Deg 3: 12 samples (79 samples > LOD[1], trace)

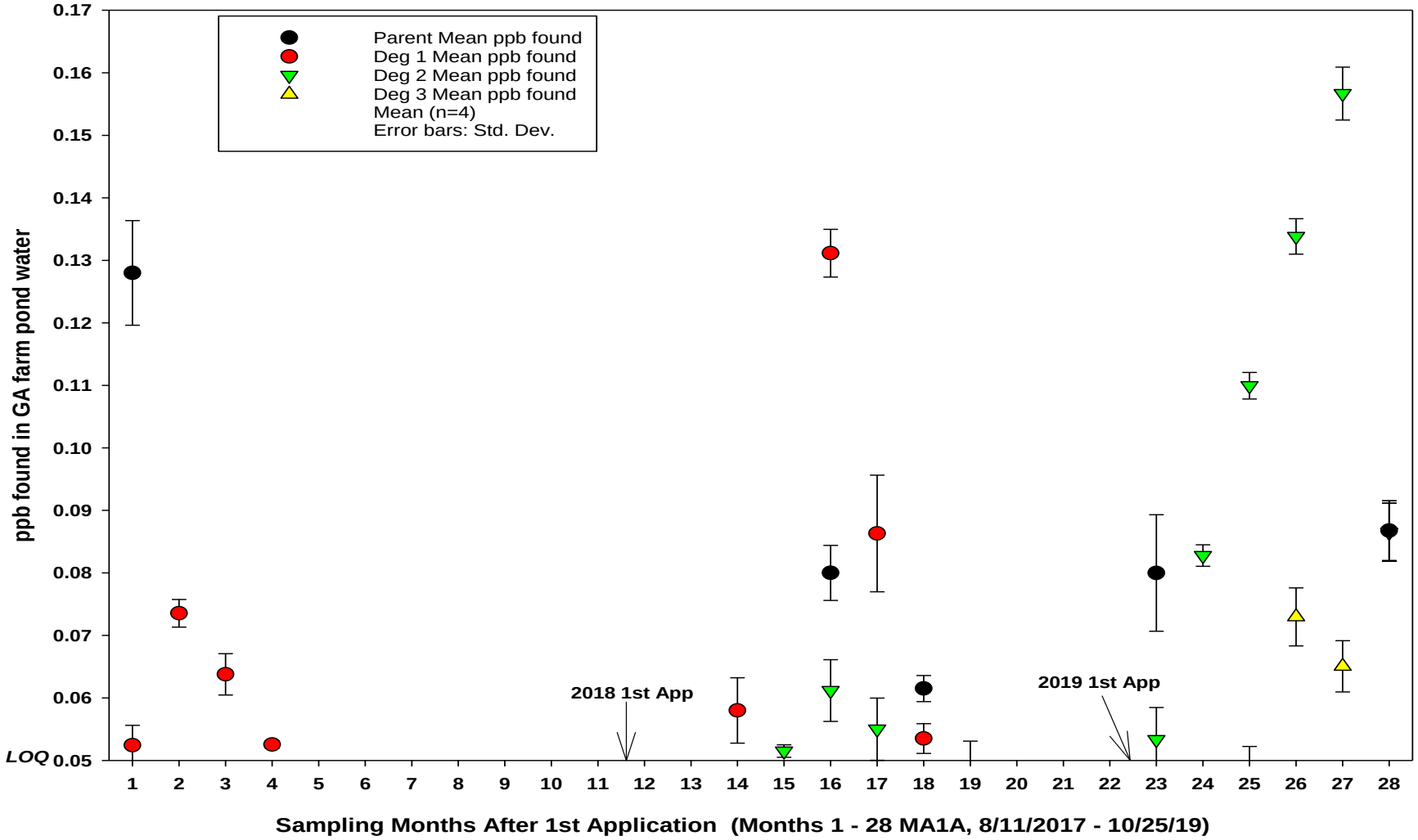
[1]LOD = 0.02 ppb, defined as concentration equivalent to lowest standard injected.

Fate in Aquatic Environments - Results
Edge-of-Pond Runoff Sample Summary

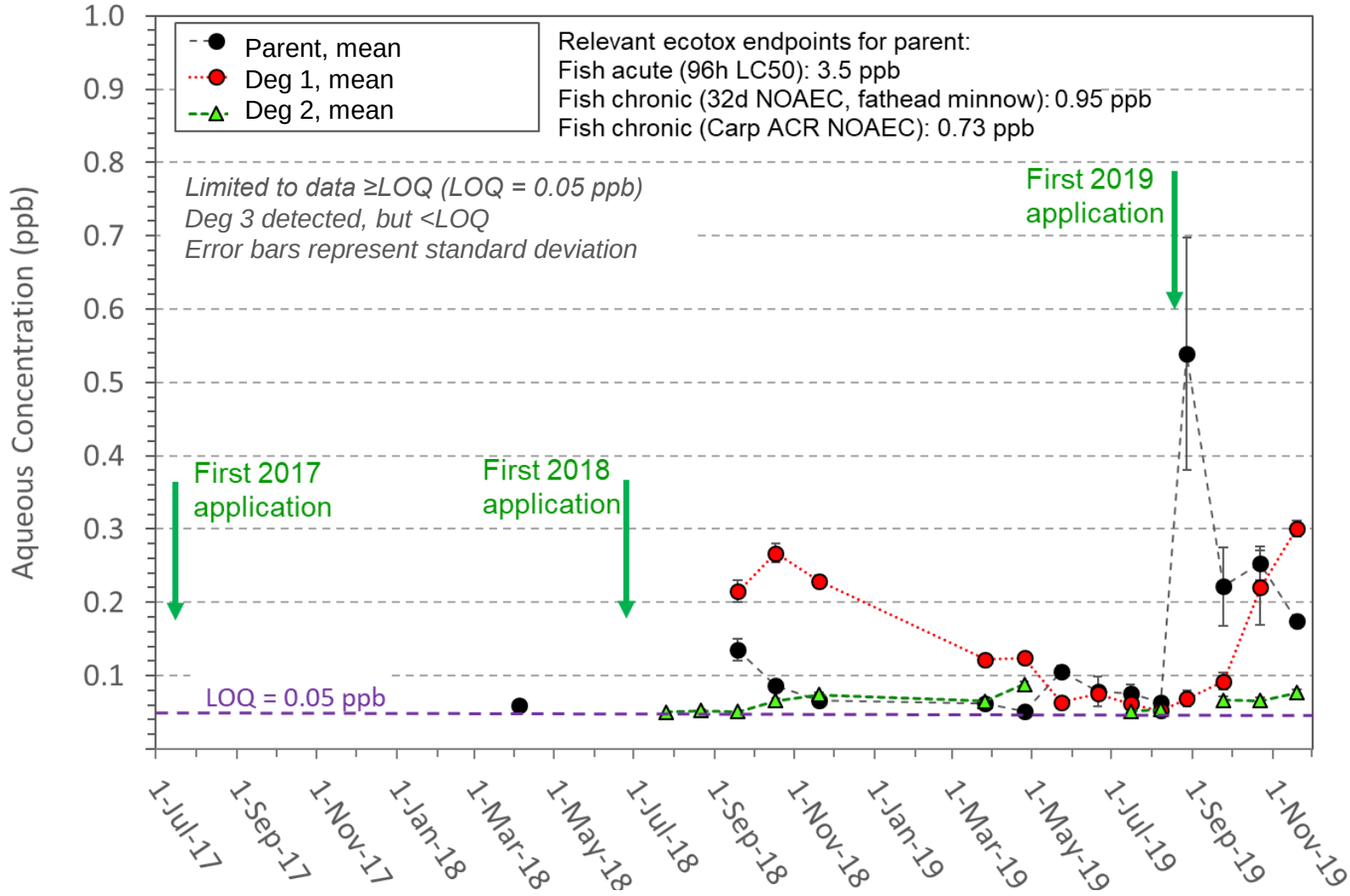
From 44 & 104 runoff events in GA & MO ...

- Transport of parent FUNG and degradates from surrounding treated catchment area to edge-of-pond confirmed in edge-of-pond runoff, and indicative of degradation occurring in treated catchment area.

Fate in Aquatic Environments – Results (GA Pond Site)
Pond Water Samples (Mean ± SD)



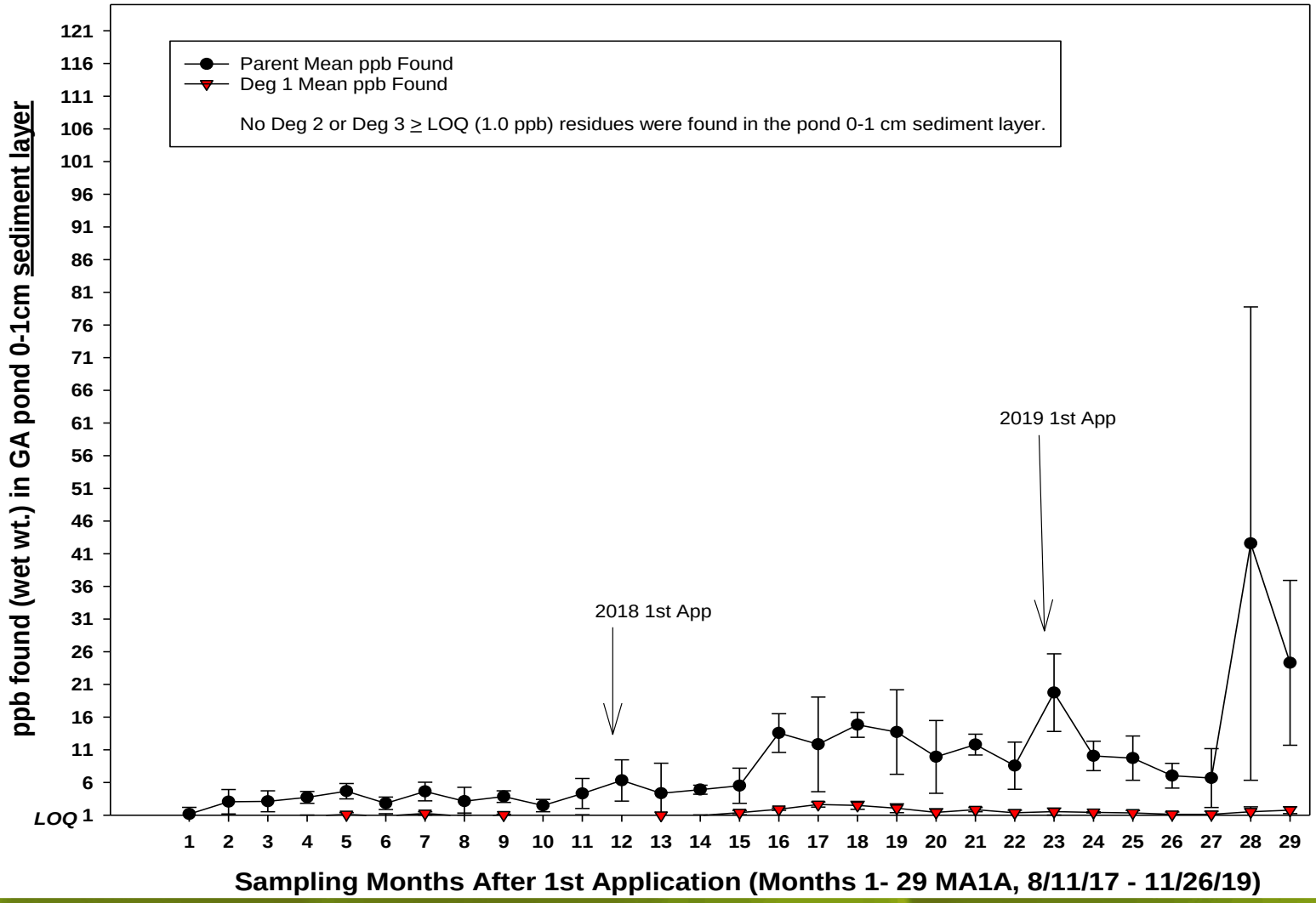
Fate in Aquatic Environments – Results (MO Pond Site)
Pond Water Samples (Mean ± SD)



Fate in Aquatic Environments - Results
Pond Water Samples in GA & MO (Summary)

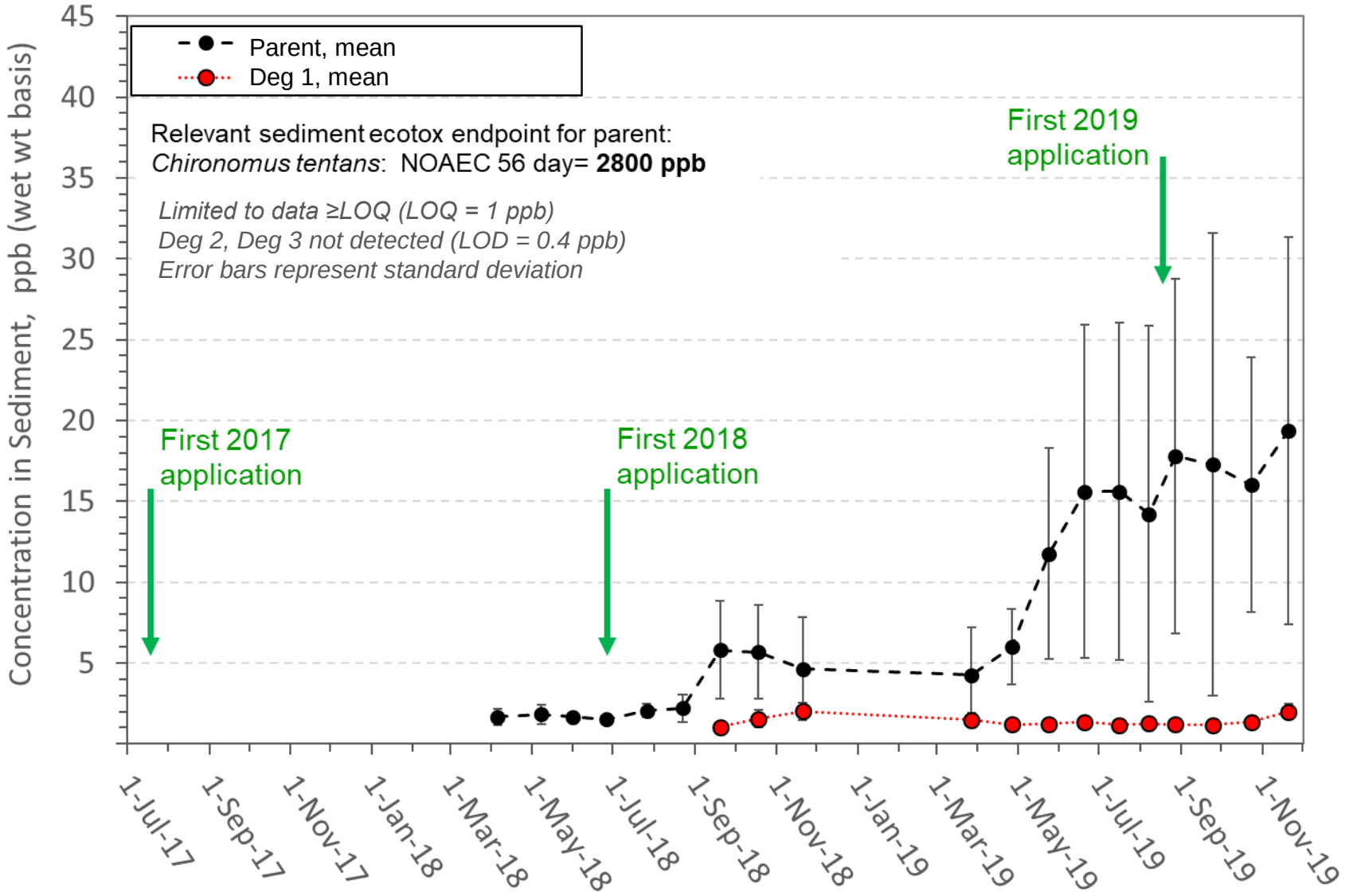
- Residue of concern is parent FUNG only.
- Fish acute=3.5 ppb
  Fish chronic (32-d NOAEC, fathead minnow)=0.95 ppb.
  Fish chronic (carp ACR NOAEC)=0.73 ppb
- MO: Highest mean FUNG [parent] in pond water was 0.54 ppb.
- GA: Highest mean FUN [parent] in pond water was 0.13 ppb.
- Highest mean FUNG [parent]s were at least 6.5- and 1.7-times lower than fish acute and chronic endpoints, respectively.
- Patterns of FUNG parent decline and degradate formation indicate degradation is occurring in GA & MO ponds.

Fate in Aquatic Environments – Results (GA Pond Site)
Pond Sediment Samples (0-1 cm; Mean ± SD)



Fate in Aquatic Environments – Results (MO Pond Site)

Pond Sediment Samples (0-1 cm; Mean ± SD)



syngenta

Fate in Aquatic Environments - Results
Pond Sediment Data (0-1 cm) in GA & MO (Summary)

- Parent FUNG is only residue of concern.
- Most sensitive sediment endpoint: *Chironomus tentans* (NOAEC, 56-d) =2,800 ppb
- MO: Highest mean FUNG [parent] in pond sediment was 19.4 ppb.
- GA: Highest mean FUNG [parent] in pond sediment was 43 ppb.
- Only FUNG parent and Deg 1 found in GA & MO pond sediments.
- Highest mean FUNG [parent]s in the GA & MO pond sediments were at least 65-times lower than the most sensitive endpoint (2,800 ppb).

Summary & Conclusions

- USEPA's initial concerns regarding FUNG included:
  - Persistent in terrestrial & aquatic environments.
  - Sediment-transported to off-site water bodies.
  - Potential accumulation in aquatic environments over time with subsequent potential acute & chronic risks to fish.
- Based on those concerns, agreed upon objectives were to:
  1. *Quantify runoff, sediment, and FUNG losses exiting 0-, 15- and 30-ft VFSs from Southeastern (GA) and Midwestern (MO) landscapes under natural rainfall and maximum label seasonal rate of FUNG solo formulation, and*
  2. *Evaluate FUNG fate and transport from the application site, through a 15-ft VFS, and into and from a farm pond under natural rainfall and maximum label seasonal rate of FUNG solo formulation.*

Summary & Conclusions (cont.)

From our results, the following conclusions can be made:

- VFS effectiveness:
  - Variability observed among plots (9) and VFS treatments (3) with no statistical differences in FUNG parent dissolved load among VFS treatments.
  - FUNG parent dissolved load numerically decreased with increasing VFS width at both sites.
  - Runoff samples contained FUNG parent and degradates at or above LOQ.

- Fate in aquatic environment (edge-of-pond runoff):
  - From 44 & 104 runoff events in GA & MO, parent FUNG + degradates reached edge-of-pond via runoff, indicative of degradation in surrounding treated catchment area.

Summary & Conclusions (cont.)

- Fate in aquatic environment (pond water):
  - Parent FUNG is only residue of concern.
  - Highest mean FUNG [parent]s in GA (0.13 ppb) & MO (0.54 ppb) pond water were at least 6.5- & 1.7-times lower than fish acute & chronic endpoints, respectively.
  - FUNG parent decline and degradate formation in GA and MO pond water indicative of degradation occurring in pond water.

- Fate in aquatic environment (pond sediment):
  - Only FUNG parent & degradate 1 found in GA & MO pond sediments.

Summary & Conclusions (cont.)

- Fate in aquatic environment (pond sediment) (cont.):
  - Most sensitive sed endpoint: *Chironomus tentans* (NOAEC, 56-d)=2,800 ppb.
  - MO: Highest mean FUNG [parent] in pond sediment was 19.4 ppb.
  - GA: Highest mean FUNG [parent] in pond sediment was 43 ppb.
  - Highest mean FUNG [parent] in GA and MO pond sediments were at least 65-times lower than the most sensitive endpoint.

Questions ??

Game camera, autosampler, and solar panel at pond outlet