Characterization and Land Application of Hydrodemolition and Diamond Grinding Slurries in NC

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Concerns

- Spills
  - what effect would a spill have
- Land application's effect on:
  - Vegetation
  - Soils
  - Rainfall runoff

Previous Studies on DGS

- CALTRANS (1997): characterization & toxicity
- Shanmugam (2004): soil pH
- DeSutter (2011): characterization, soil infiltration, plant response
- Nebraska DOT (2015): plant and soil response

Objective

- Characterize Diamond grinding (DGS) & Hydrodemolition slurry (HOS)
- Document effect of land application at lime rates (target soil pH=6.2) on:
  - soils & grasses
  - runoff from application areas

Methods

- Collected and analyzed HOS from 3 bridges; DGS 2 highways
- Greenhouse trials
  - Applied HOS & DGS at liming rate and greater
  - HOS to 3 soils growing fescue (cool season)
  - DGS to 3 soils growing bahiagrass (warm season)
- Field trial
  - Applied HOS & DGS at liming rate and greater
  - Analyze runoff from HOS & DGS applied to plots of bermudagrass

Characterization: Sampling HOW

Characterization: Sampling HOW

Sampled HOS at midpoint of storage tank and out of truck
Analyzed for nutrients, soilds, metals, aggregate organics, and TCLP

Greenhouse Trial

Mix DGS and HOS into soil at 50, 100, 200 and 300% recommended rate
Plant fescue or bahiagrass
Maintain soil moisture at 90% of field capacity
After 3 months harvest biomass and collect soil samples

Field Trial (limited)

Installed plots ~2 months before application
Applied DGS and HOS to plots at 100 and 150% recommended rate
Collected runoff ~4 months
Harvested biomass

Field Trial (Applicator)

Field Trial (DGS on Grass)

Field Trial (Runoff Collection)

Measure rainfall

Collect all runoff, measure and sample

Analyze for pH, TSS, TP, TKN, NH_3-N, NOx-N, Pb, Zn, Mn, and Cu

Results: Characterization HOS

- Most of nutrients and metals contained in solids
- High levels of pH, Ca, Mg, Cl, solids, and TP
- Elevated levels of TOC and BOD_5
- Low levels of FC, nitrogen, most metals, toxic compounds (TCLP)

Results: Characterization DGS

- P, K, and metals concentration greater in DGS compared to HOS
- Most of nutrients and metals contained in solids
- High levels of pH, Ca, Mg, Cl, solids, and TP
- Elevated levels of TOC and BOD_5
- Low levels of most metals and toxic compounds (TCLP)

Results: Greenhouse HOS Trial

- No detrimental effect of HOS application at recommended levels for two soils
- Fescue yields decreased from 2x to 3x the recommended application rate
- HOS application increased soil pH & Ca levels

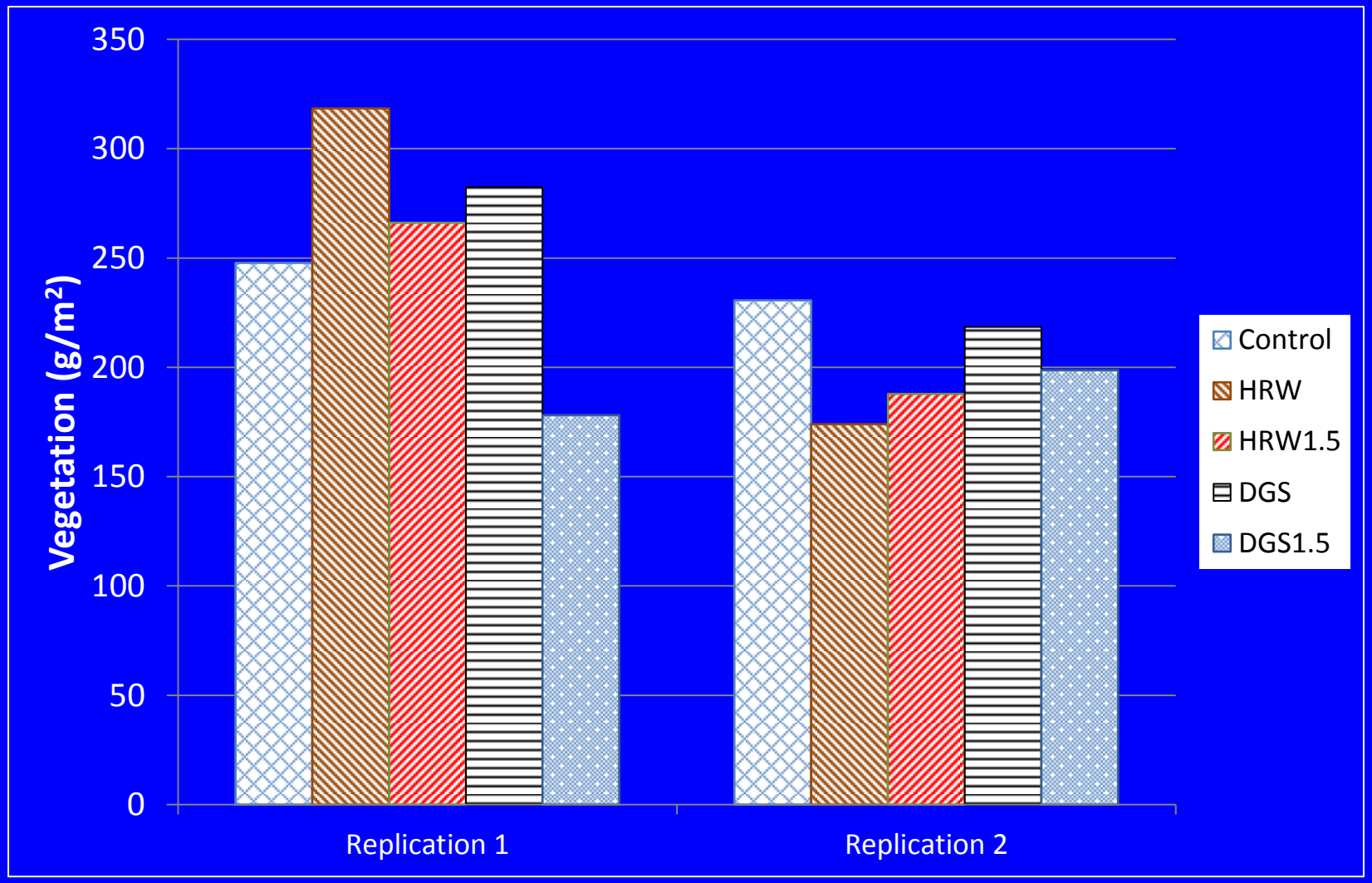
Results: Greenhouse DGS Trial

- No detrimental effect on bahiagrass of DGS at recommended rates
- Fescue yields decreased at >2.5x the recommended application rate
- Plant Mn and Zn levels decreased as DGS application rate increased (pH>7)
- DGS application increased soil pH & Ca levels

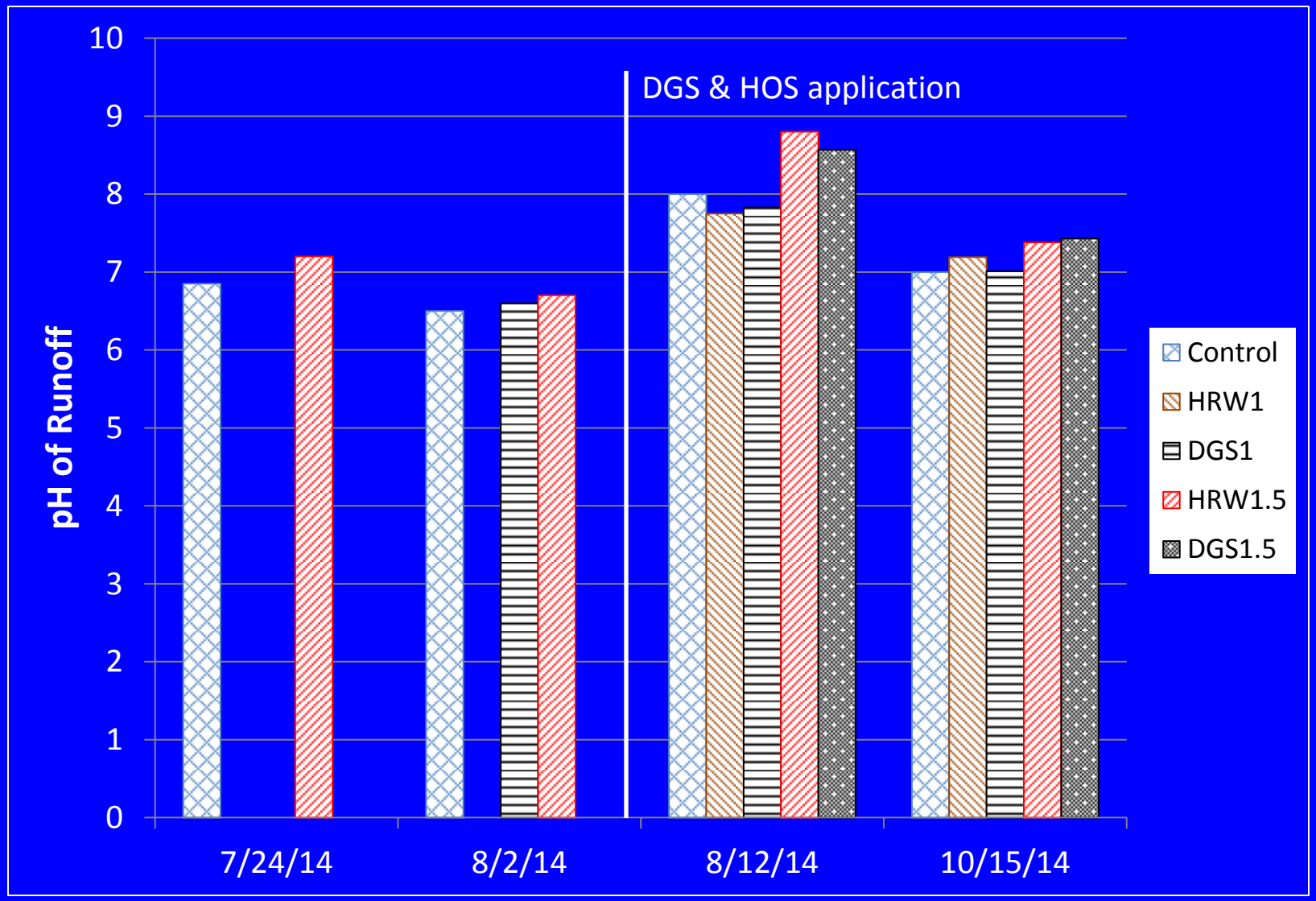
Results: Field Trial

- No detrimental effect on bermudagrass of HOS and DGS at recommended or 1.5x rates
- At recommended appl rates:
  - No increase in pH or nitrogen in runoff
  - No increase in Zn, Mn, or Pb in runoff
  - Likely no effect on TSS in runoff
  - Increase in Ca in runoff, but no known negative effects of Ca in surface waters

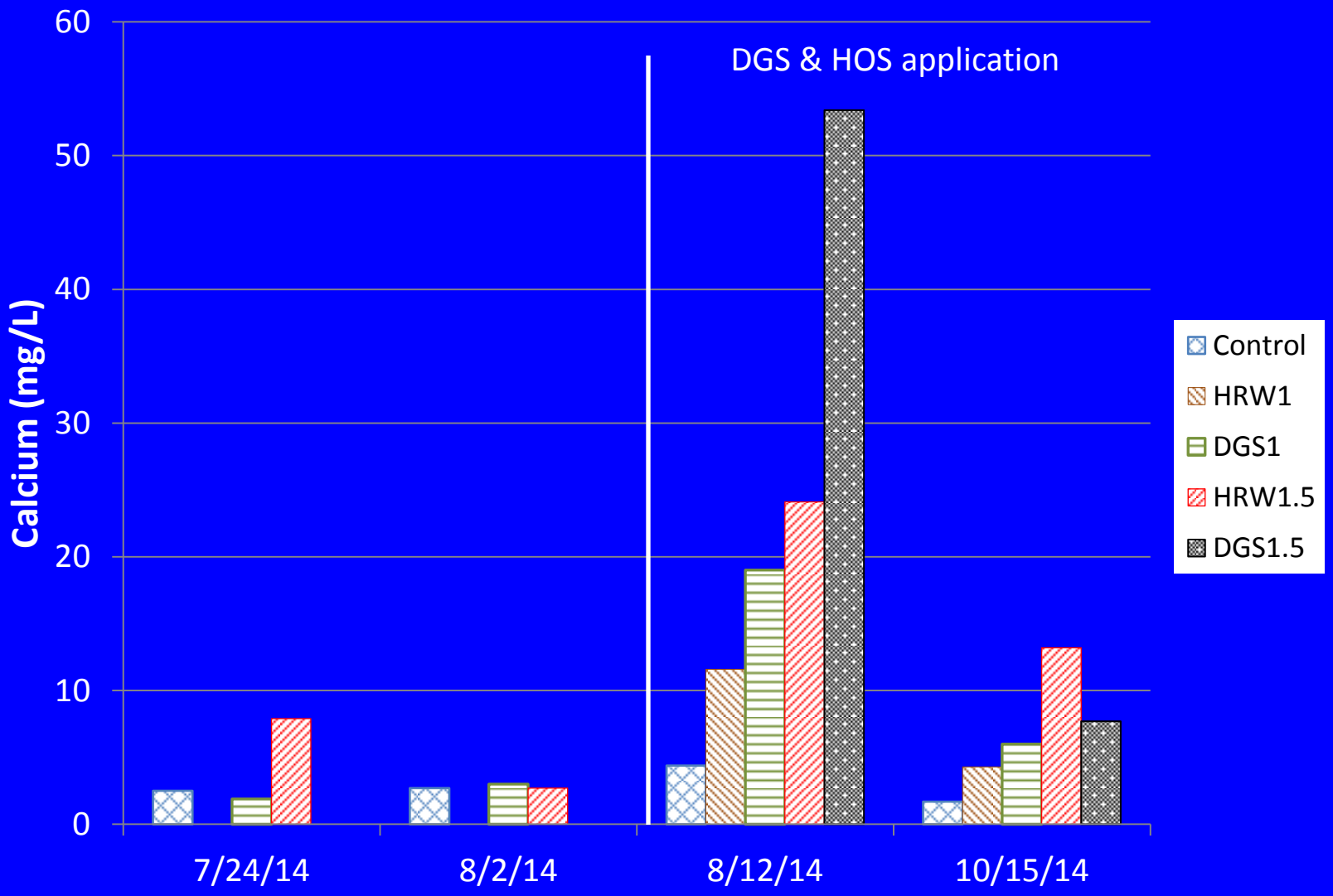
Field Trial (Vegetation)



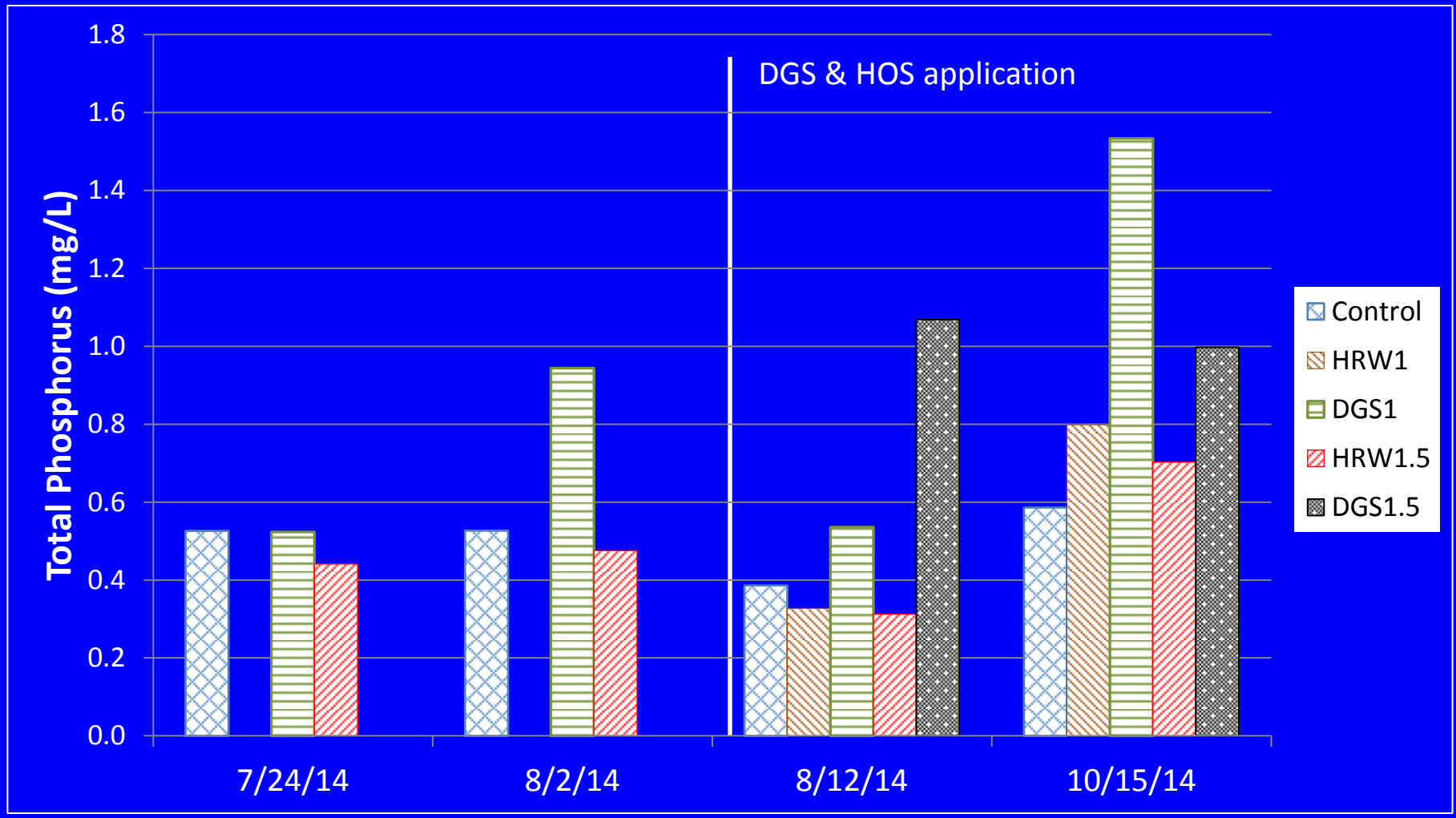
Field Trial


pH of Runoff
10
9
8
7
6
5
4
3
2
1
0
DGS & HOS application
7/24/14
8/2/14
8/12/14
10/15/14
Control
HRW1
DGS1
HRW1.5
DGS1.5

Field Trial


60
50
40
30
20
10
0
Calcium (mg/L)
DGS & HOS application
7/24/14
8/2/14
8/12/14
10/15/14
Control
HRW1
DGS1
HRW1.5
DGS1.5

Field Trial


Total Phosphorus (mg/L)
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
DGS & HOS application
7/24/14
8/2/14
8/12/14
10/15/14
Control
HRW1
DGS1
HRW1.5
DGS1.5

Conclusions

- Characterization
  - Difficult to obtain representative samples
  - DGS & HOS: high pH & Ca
  - Elevated levels of some compounds, but nothing hazardous
- Effects on plants
  - No detrimental effect on fescue, bahiagrass, or bermudagrass at recommended application rates (or 1.5x)
- Effects on soils
  - Raises pH, but no other detrimental effects at recommended application rates (or 1.5x)
- Effects on runoff
  - No increase in Zn, Mn, or Pb in runoff
  - Likely no effect on TSS in runoff
  - Increase in Ca in runoff