NC STATE UNIVERSITY

NC State Research Results

Management, Disposal, and Beneficial Reuse of Diamond Grinding Slurries

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NCSU Diamond Grinding Slurry (DGS) Study

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Overview of Diamond Grinding Slurry (DGS)

Definition: By-product of concrete road grinding operations; mixture of water and fine particles of concrete.

Environmental challenges: High pH, potential impacts on soil and water quality.

N road infrastructure expansion increases DGS production.

Need for sustainable and environmentally sound disposal and reuse strategies.

NC State DGS Studies

1. Categorization of Diamond Grinding Slurry and the Potential for Recycling or Reuse – A Review

2. The Potential for Improvement of Diamond Grinding Slurry Management in North Carolina

NC State DGS Studies

1. **Categorization of Diamond Grinding Slurry and the Potential for Recycling or Reuse – A Review**

   Comprehensive literature review examining existing research on the management, disposal, and potential reuse of Diamond Grinding Slurry (DGS). Synthesizes findings across multiple studies to inform the understanding of DGS impacts and potential reuse applications

   - Categorization of DGS
   - Impacts on Soil and Vegetation
   - Recycling and Reuse Potential

Categorization and Properties of DGS

Chemical Composition:

- DGS contains fine particles of concrete mixed with water, resulting in a high-pH slurry.
- pH values range from 9.6 to 12.6, depending on the specific project and materials used.
- Variability chemical composition such as (Ca, Mg, Na, and N forms).
- Some samples exceed regulatory limits for heavy metals like lead, but these are often bound to solids and unlikely to leach into the environment.

Physical Composition:

- Particle size distribution varies significantly among grinding projects, influenced by:
  - The concrete mix used during road construction.
  - The age and condition of the road surface.
  - The grinding techniques and machinery.
- Fine particles can potentially clog soil pores if land-applied improperly.

Categorization and Properties of DGS

Environmental Variability

- Influence of Roadway Materials:
  - Older roads tend to produce DGS with different chemical and physical properties compared to newer road surfaces.
  - The use of specific admixtures and aggregates during initial road construction affects DGS composition.
- Influence of Grinding Operations:
  - Operational parameters such as grinding depth, cooling water usage, and equipment design impact the characteristics of the slurry.

Soil and Environmental Impacts

Limited long-term effects on soil physical properties (e.g., infiltration).

Soil chemical changes include short-term pH increases and possible salinity impacts (EC increases).

pH and EC values for I77 DGS treated with PAM blends.

Treatment	pH	EC (dS/m)
Control	9.90 a	1.95 a
AN 913 VHM	9.69 b	1.68 a
APS 705	9.89 a	2.17 a
APS 740	9.91 a	2.29 a
FA 920 VHM	9.96 a	1.95 a

Concentrations of DGS samples from various road grinding projects.

Collection Site	Concentration	
	g/g	g/L
I77	1.54	1537
I4400	0.30	296
I77/40	0.62	623

NC State DGS Studies

2. The Potential for Improvement of Diamond Grinding Slurry Management in North Carolina

Experimental evaluation of innovative approaches for managing and reusing DGS in North Carolina. Provides evidence for improving DGS disposal practices and highlights its potential as a cost-effective and sustainable resource for construction projects in North Carolina.

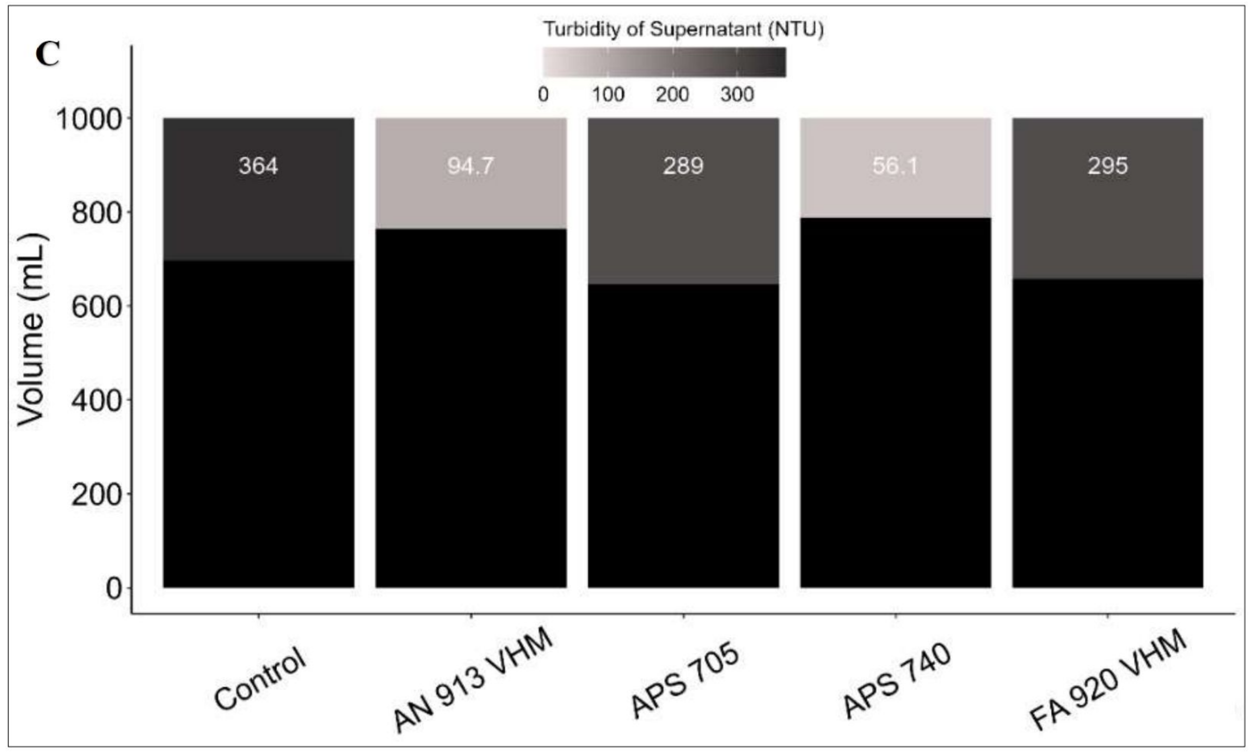
- Advanced Settling with Polyacrylamide (PAM)
- Recycling DGS Solids as Lime

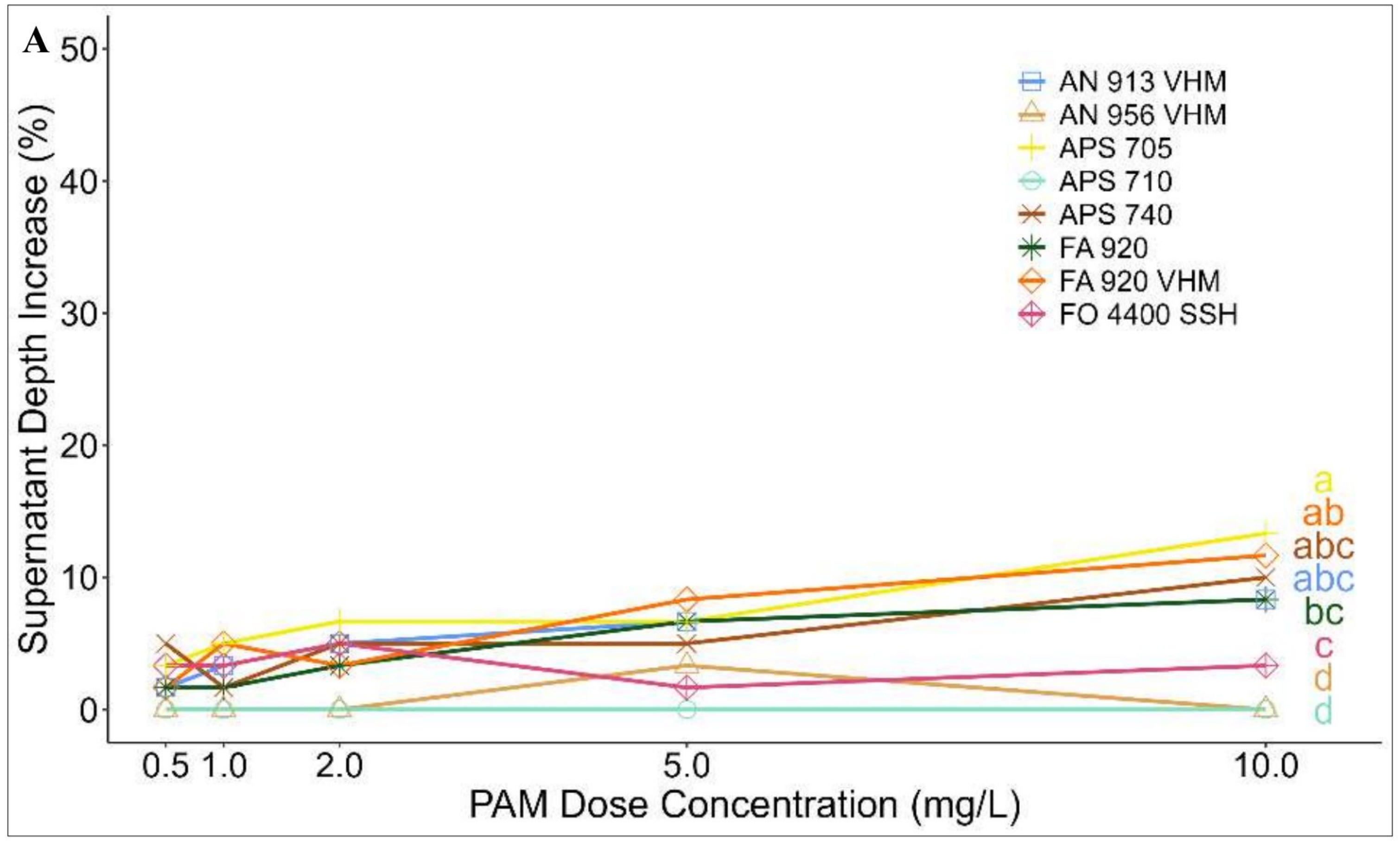
Advanced Settling with Polyacrylamide (PAM)

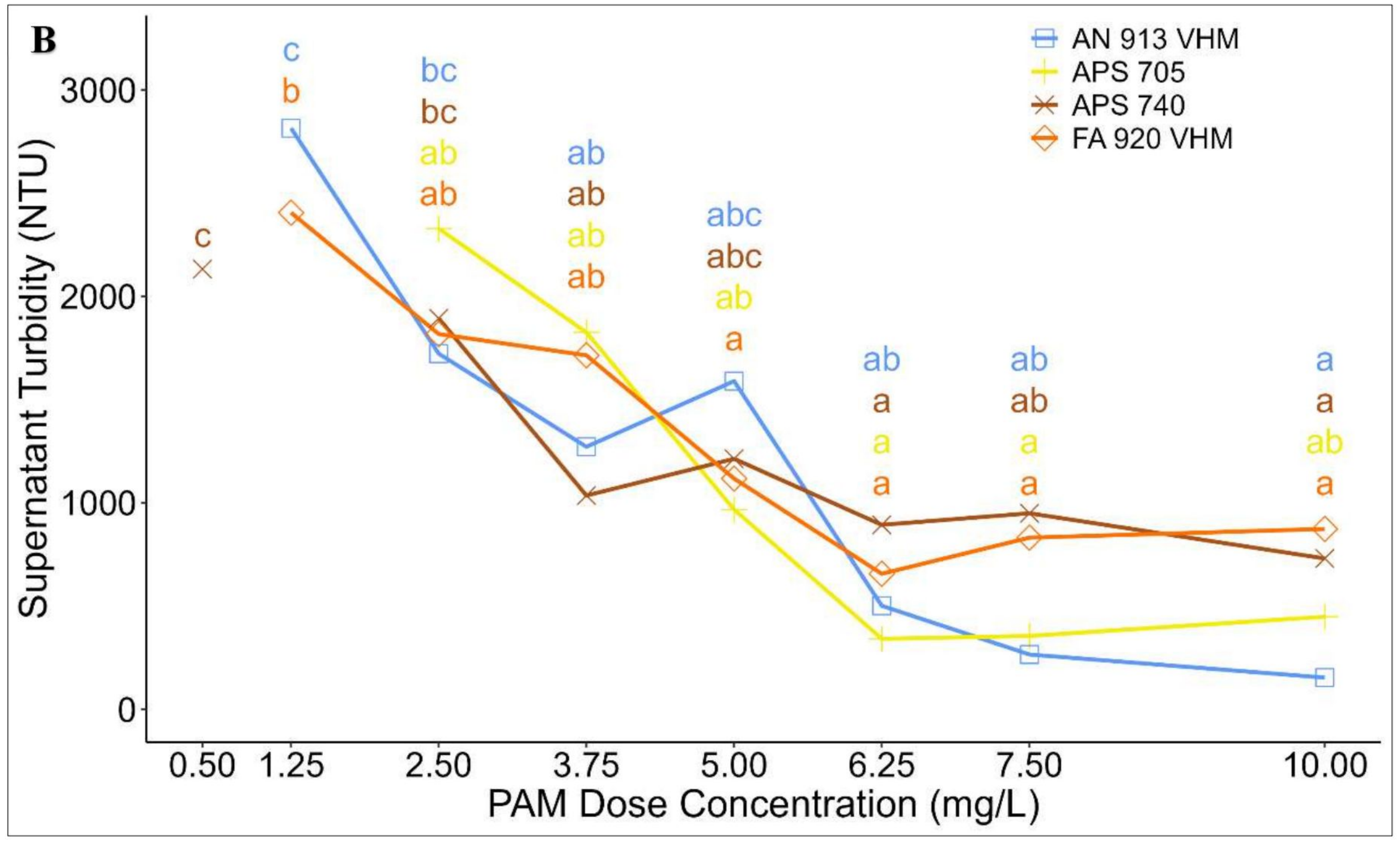
- Tested the effectiveness of PAM for improving the sedimentation of DGS in sediment basins.
- Conducted dose-response tests with various PAM formulations to determine optimal concentrations for turbidity reduction and solids settling.
- PAM Screening and Selection:
  - Tested multiple PAM chemistries (anionic, cationic, non-ionic) to identify the most effective flocculants.
- Dose-Response Testing:
  - Selected top-performing PAMs from screening and tested them over a wider concentration range to determine the optimal dose for reducing turbidity and enhancing solids settling.
- Settleable Solids Testing:
  - pH and EC were analyzed for treated solids to assess chemical changes due to PAM addition.

Advanced Settling with Polyacrylamide (PAM)

- Enhanced flocculation of fine particles improves settling efficiency.
- Research showed significant reductions in turbidity with tailored PAM applications.







Recycling DGS Solids as Lime

- Soil incubation experiments with sandy loam and clay loam soils amended with DGS at varying rates to assess pH and electrical conductivity changes over time.
- Seed germination trials with four vegetation species (e.g., rye grain, Bermudagrass) to evaluate the effects of DGS on plant establishment.
- DGS Application Rates
- Soil Incubation Study
- Seed Germination Study

Recycling DGS Solids as Lime

Potential for DGS solids to replace lime for soil pH adjustment during revegetation.

Experiment results:

- Increased soil pH without reaching salinity thresholds.
- Successful seed germination for Bermudagrass, centipede grass, Kentucky bluegrass, and rye grain.

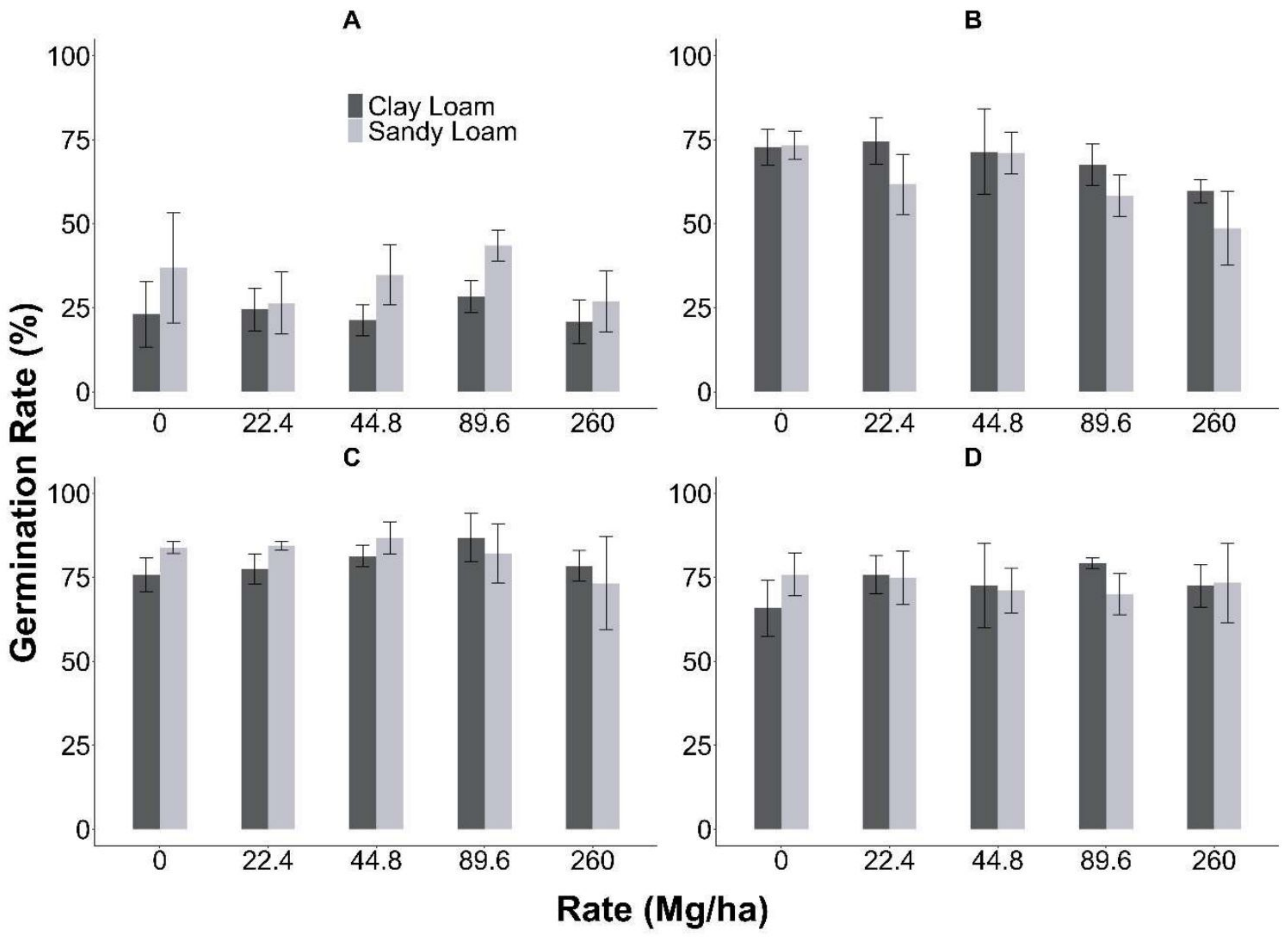


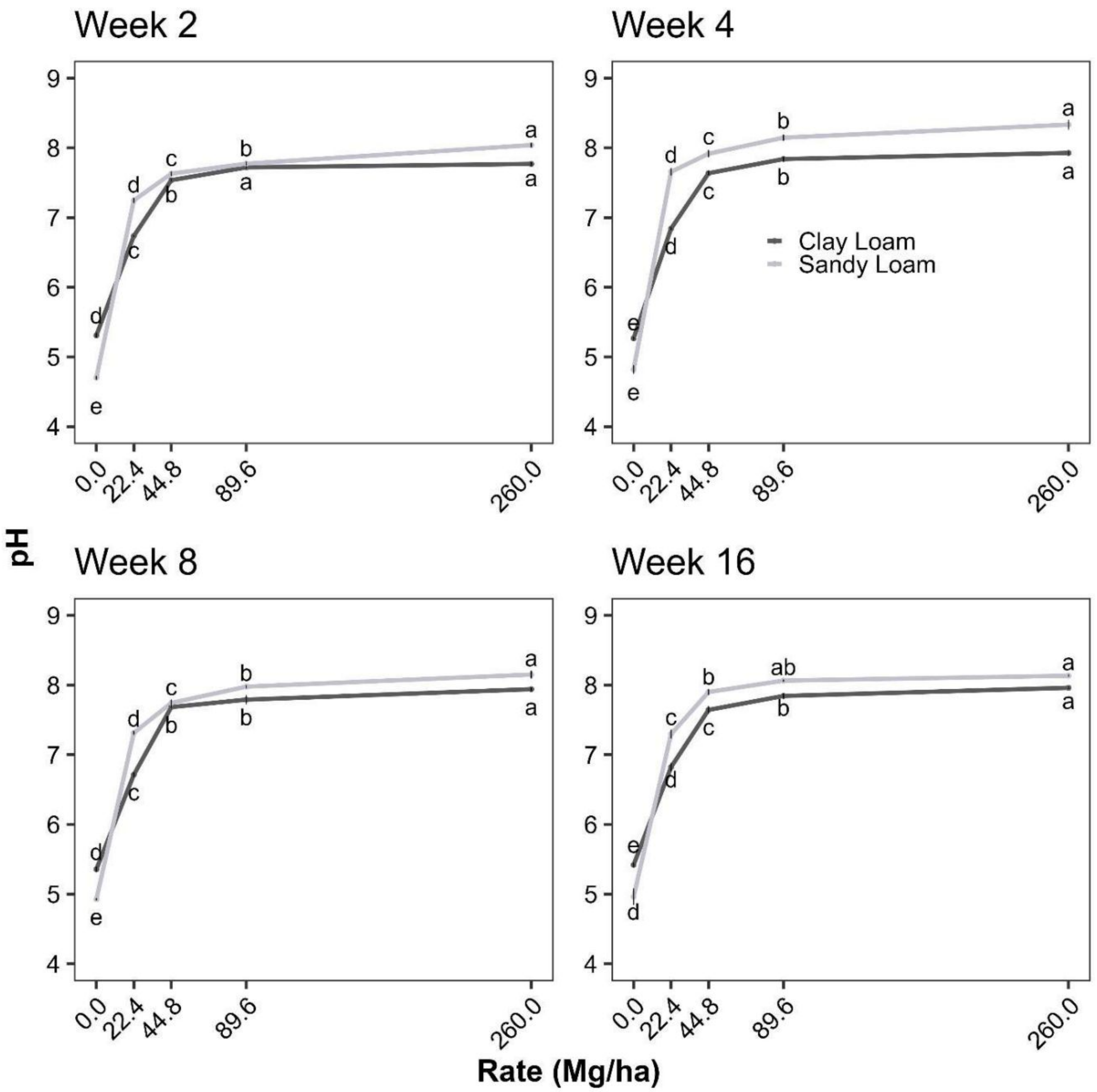
Figure 3.7. *Trial 2 seed germination percentages for Bermuda grass (A), centipede grass (B), Kentucky bluegrass (C), and rye grain (D) with increasing rates of DGS.* Error bars represent one standard deviation. Differences between treatment rates for each soil were not found to be statistically different with α = 0.05.

Impacts on Vegetation Establishment

Demonstrated feasibility of using DGS as a liming agent under controlled rates.

Established grasses and new seedlings generally tolerate DGS at recommended application rates.

Over-application may hinder growth due to excessive pH.



Key Findings

Composition and Properties of DGS

- High pH (9.6–12.6) with significant variability in chemical composition (e.g., calcium, magnesium, nitrogen).
- Fine particle size may clog soil pores if not managed properly.
- Heavy metals typically below hazardous thresholds but require site-specific testing.

2. Environmental and Soil Impacts

- **Soil Chemical Properties:**
  - Short-term increases in pH and electrical conductivity (EC).
  - Minimal long-term effects on soil chemical or physical properties.
- **Vegetation Impacts:**
  - DGS application supports grass establishment if applied within pH and salinity tolerances.

Innovative Management Approaches

- **Enhanced Sedimentation with PAM:**
  - Polyacrylamide (PAM) significantly improved DGS settling efficiency and reduced turbidity in sediment basins.
- **Reuse as a Lime Substitute:**
  - DGS solids effectively increased soil pH without exceeding salinity thresholds.
  - Successful germination of rye grain, Bermudagrass, centipede grass, and Kentucky bluegrass in amended soils.

Thank you!

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