

Growth of plants potted with a P-retaining base-layer of FeSO_4 -amended pine bark

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INTRODUCTION

Phosphorus (P) is the limiting nutrient for eutrophication in freshwater.

Excess P results in toxic algae blooms that disrupt aquatic ecosystems and contaminate drinking water sourced from surface waters (Fig. 1).

Agriculture is a primary source of P runoff to surface waters.

In container nursery crop production, up to 68% of P fertilizer can end up in the leachate [1]. Pine bark, a common container substrate used in the Eastern US, poorly retains P [2].

Substrate amendments can be a solution to reduce P in leachate.

Adding a base-layer of ferrous sulfate (FeSO_4)-amended pine bark (i.e., filter layer) to nursery containers can reduce effluent P concentrations (Table 1) [3]. FeSO_4 has been used for decades to remove P from wastewater.

Table 1. Phosphorus removal efficiency with amended pine bark.

P removal using amended pine bark substrate	
Amendment	P removal efficiency (%)
Dolomite	15
FeSO_4	94
FeSO_4 and Dolomite	91



Figure 1. Toxic algae blooms in Lake Erie in 2014.

OBJECTIVE

Evaluate the effect of a P-sorbing filter layer of pine bark amended with ferrous sulfate, dolomite, or their combination on plant growth in containerized crop production.

MATERIALS AND METHODS

Buddleia davidii (butterfly bush) were potted using two different layers of amended bark (Fig. 2), with seven replications per treatment (Fig. 3).

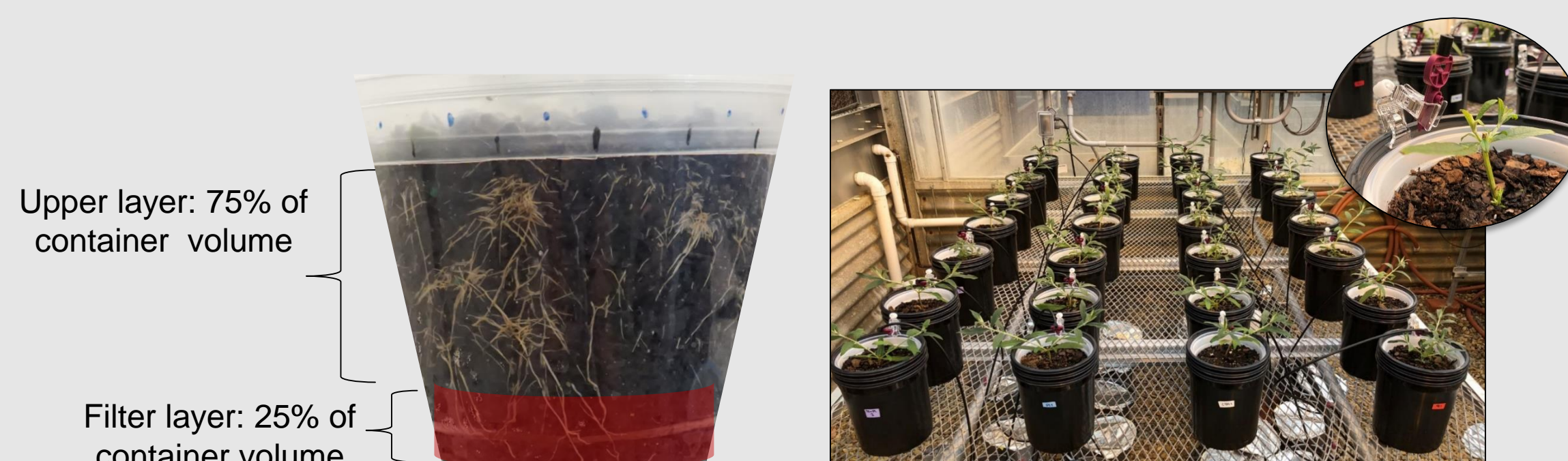


Figure 2. Layers of amended substrate.



Figure 3. Experiment arrangement in the greenhouse.

Upper layer:

Bark substrate was amended with:

- 2.97 kg/m³ pulverized dolomite
- 0.89 kg/m³ Micromax
- 11.8 kg/m³ controlled release fertilizer (3- to 4-month release)

Filter layer treatments:

Bark substrate was amended as follows:

- No amendments (CTRL)
- 5.93 kg/m³ pulverized dolomite (DL)
- 2.97 kg/m³ FeSO_4 (Fe)
- 5.93 kg/m³ pulverized dolomite and 2.97 kg/m³ FeSO_4 (Fe+DL)

MATERIALS AND METHODS

Data collection

Every week:

- Growth index (GI) [(widest width + perpendicular width + height)/3].
- Root tracings and analysis using WinRhizo software to determine total root length of the visible roots against the clear container walls (Fig. 4).

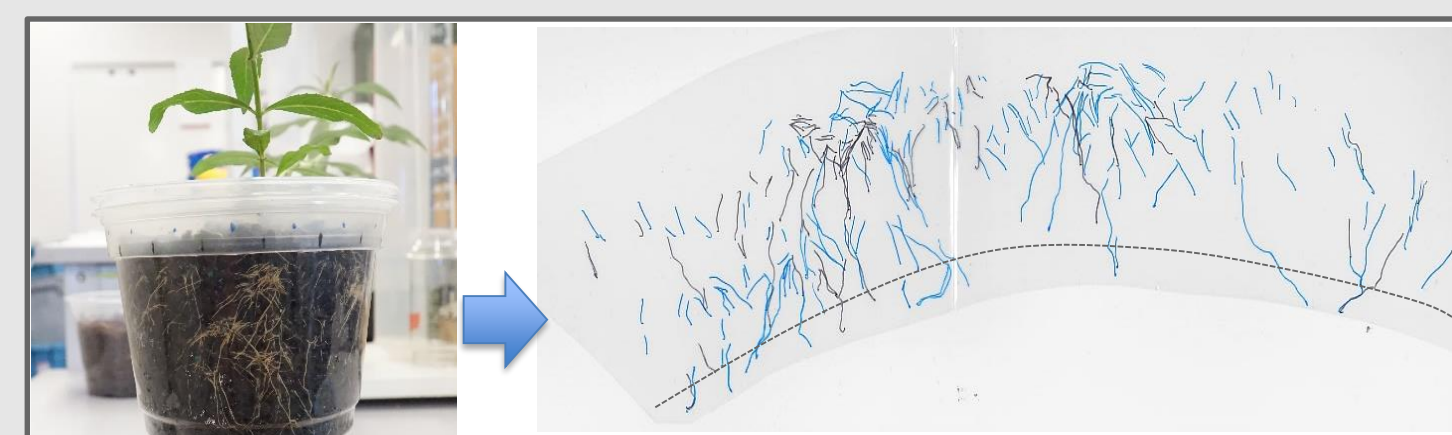


Figure 4. Visible roots against the clear container traced on plastic templates.

Fifty-four days after initiation (DAI):

- Final root length in the bottom of the root ball
- Dry weight
- pH of the filter layer which was attained using Saturated Media Extraction

RESULTS

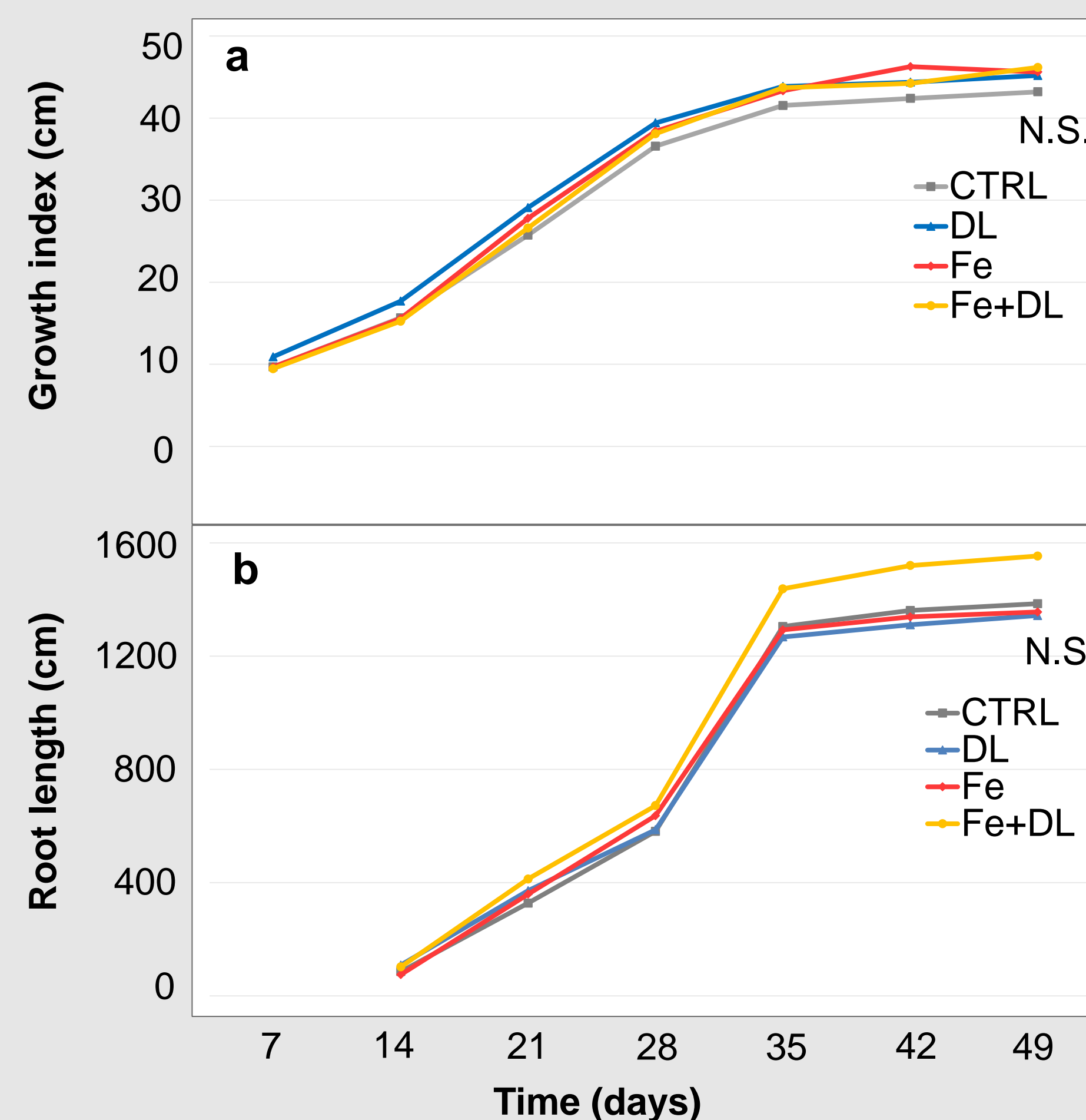


Figure 5. Growth index and total root length of the visible roots against the container walls.

- Growth index of butterfly bush was unaffected by substrate treatments (Fig. 5a).
- Total root length over time was unaffected by substrate treatments (Fig. 5b).
- Shoot and root dry weight presented similar results as GI and total root length (data not shown).

RESULTS

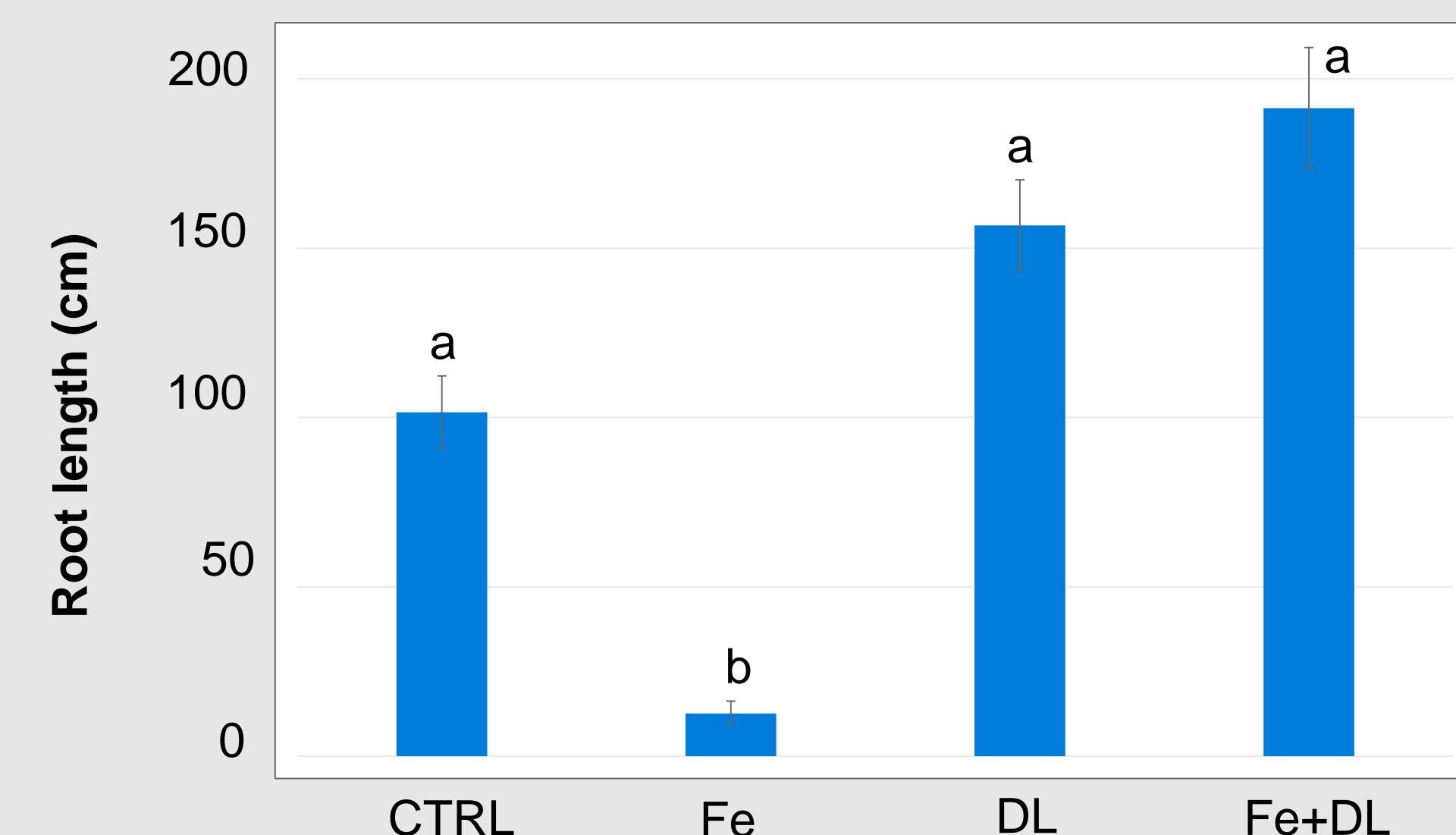


Figure 7. Root length in the bottom of the container at the end of the experiment.

- At 54 DAI, root length in the bottom of the root ball was 88% lower in the Fe treatment compared to the control (Fig. 7).

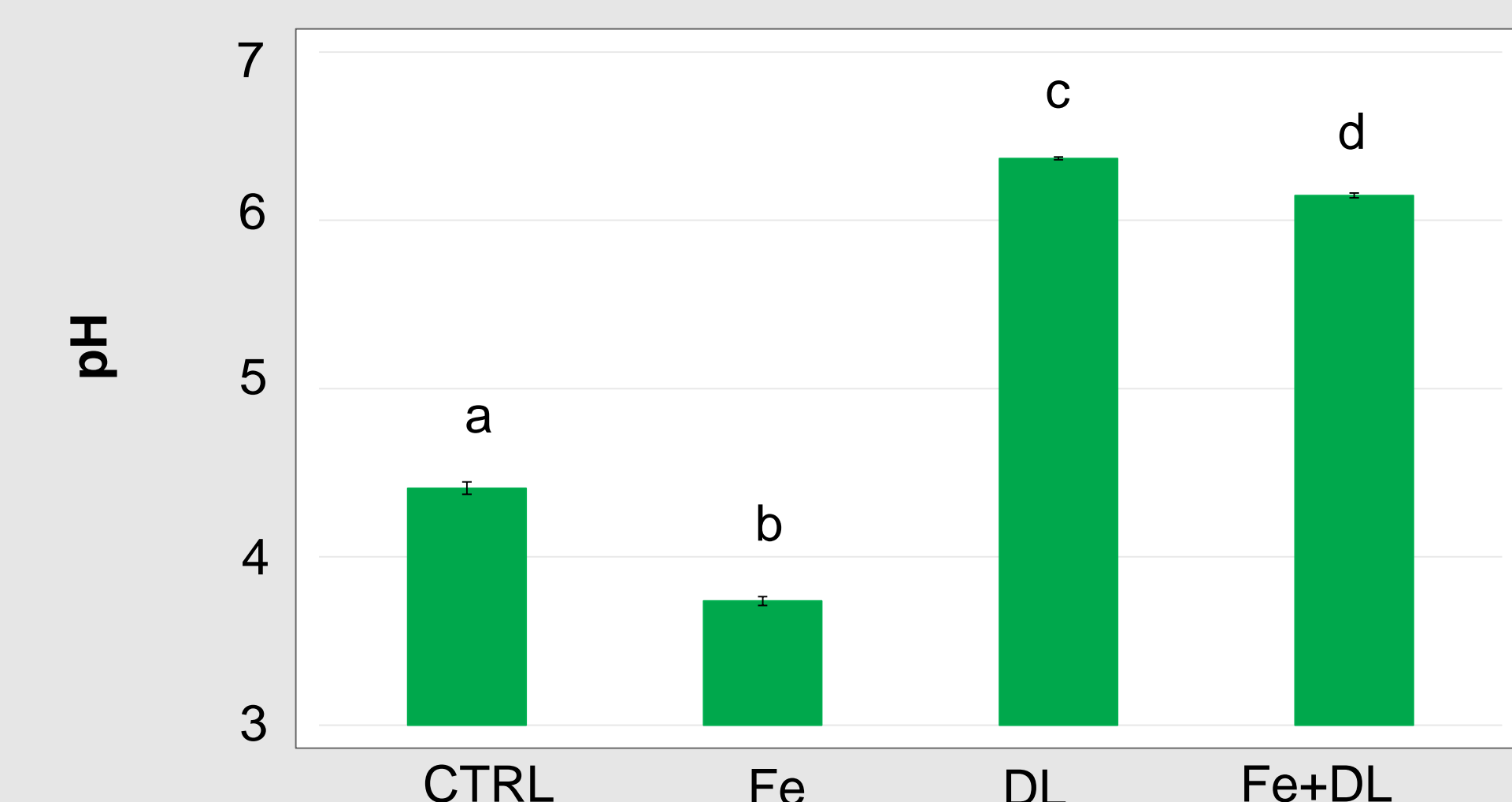


Figure 8. pH in the filter layer substrate.

- FeSO_4 reduced the pH by 0.67 units relative to the control (Fig. 8).
- Dolomite corrected the acidification caused by FeSO_4 , increasing the pH to 6.15 (Fig. 8).

CONCLUSIONS

- Buddleia davidii* shoot growth was not affected when grown with a filter layer containing FeSO_4 . However, root growth in the filter layer was reduced when using only FeSO_4 .
- By utilizing a filter layer with both FeSO_4 and dolomite, P in leachate can be reduced without affecting plant growth.
- Additional research is needed to ensure that an FeSO_4 amended filter layer is adequate for use in a variety of plant taxa.

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