

THE EFFECTS OF ENHANCED MINERAL WEATHERING

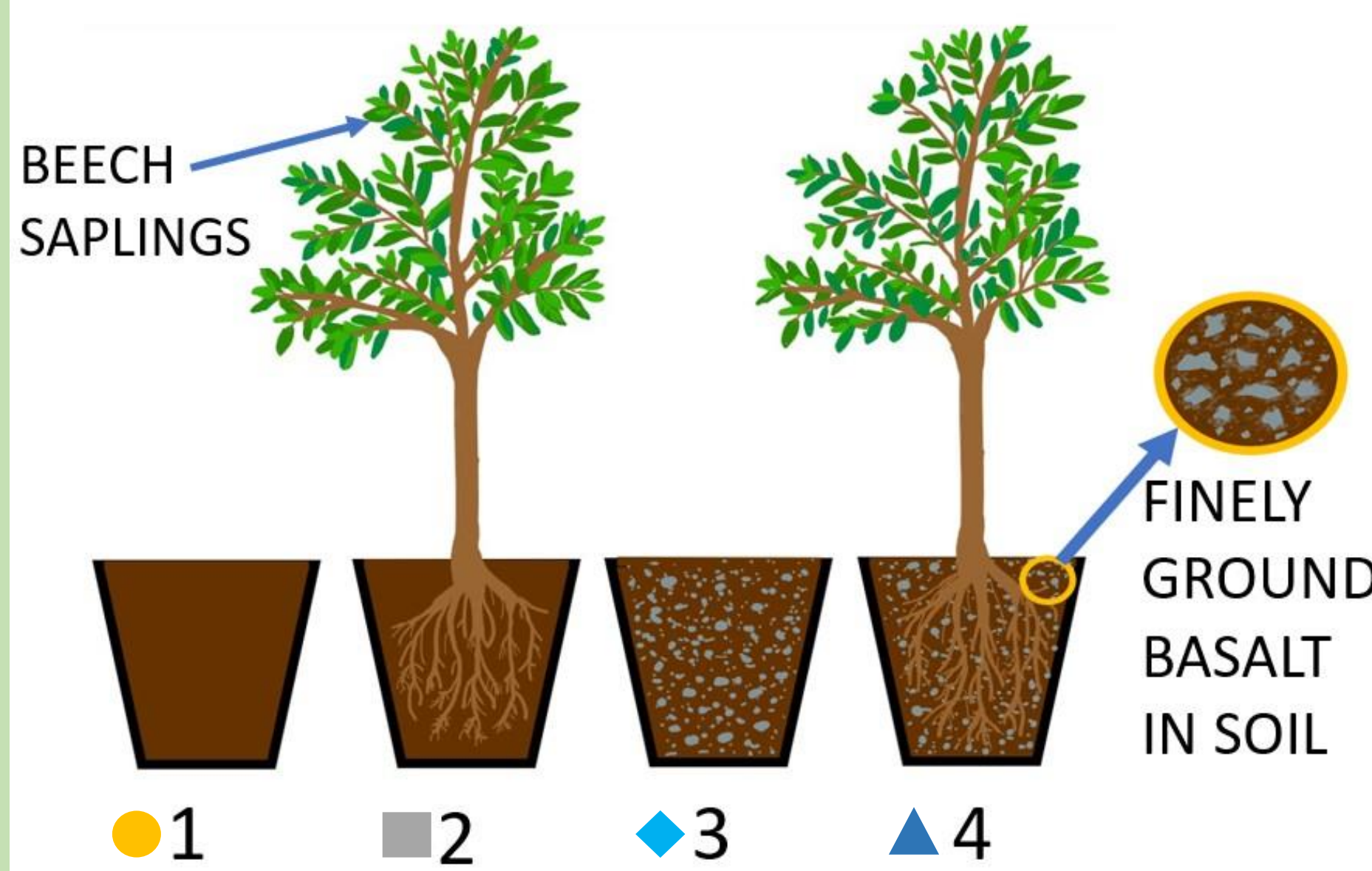
Research by Ellesha Fielding, supervisor Professor Mark Hodson at the University of York, funded by The Laidlaw Foundation

KEY FINDINGS

- The research hypothesis: Enhanced mineral weathering increases soil leachate pH and metal cation concentrations, soil microbial activity, and plant growth.
- The experimental data does not support the hypothesis.
- This is likely because measurements were made over four weeks and silicate weathering can take years. A greater sample size for each treatment group and measurements made over a longer research period should provide sufficient data to prove or disprove the hypothesis.

METHODOLOGY

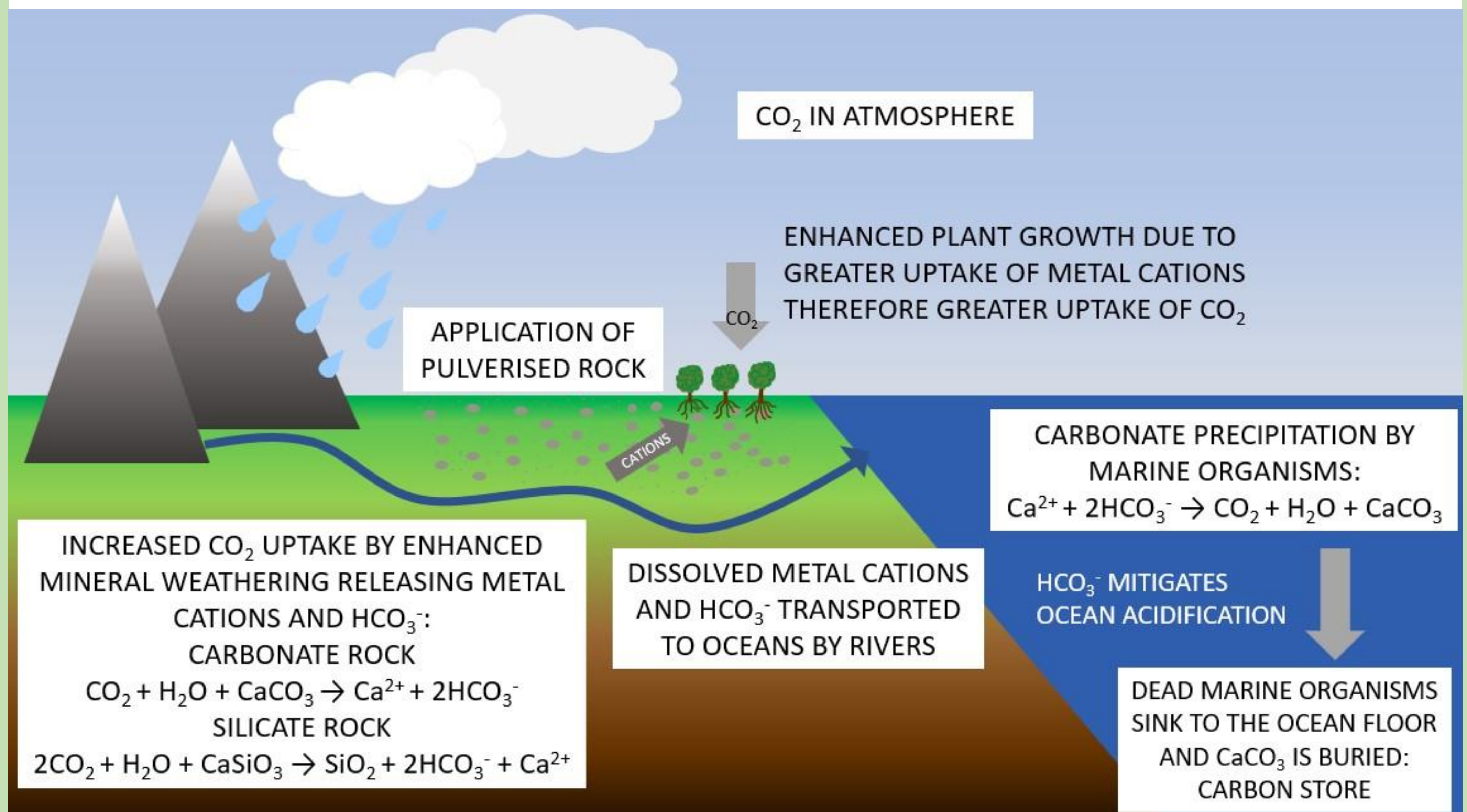
Four soil treatment groups were prepared were four samples in each group, giving a total sample size of 16:



- Basalt used as it is readily available: 0.3kg per pot.
- Beech tree saplings used as the research focus is non-agricultural.
- 16 samples watered weekly with deionised water: leachate collected, pH measured, then samples frozen.
- After four weeks, multi-element analysis conducted for the 64 leachate samples on the ICP-OES.
- Plant growth measured.
- Microbial respiration rates calculated: 50g soil from each treatment group stored in an airtight container with 10mL of NaOH, after a week the NaOH is titrated with HCl to calculate CO₂ absorbed and therefore CO₂ respired.

INTRODUCTION

Weathering is the breakdown of rocks at the Earth's surface. Enhanced mineral weathering is where crushed silicate-bearing rocks are applied to soil to increase atmospheric CO₂ uptake. Mineral weathering also releases metal cations and produces hydrogen carbonate (HCO₃⁻), which is a source of alkalinity that reduces ocean acidification. This is illustrated in the graphic below:



RESULTS

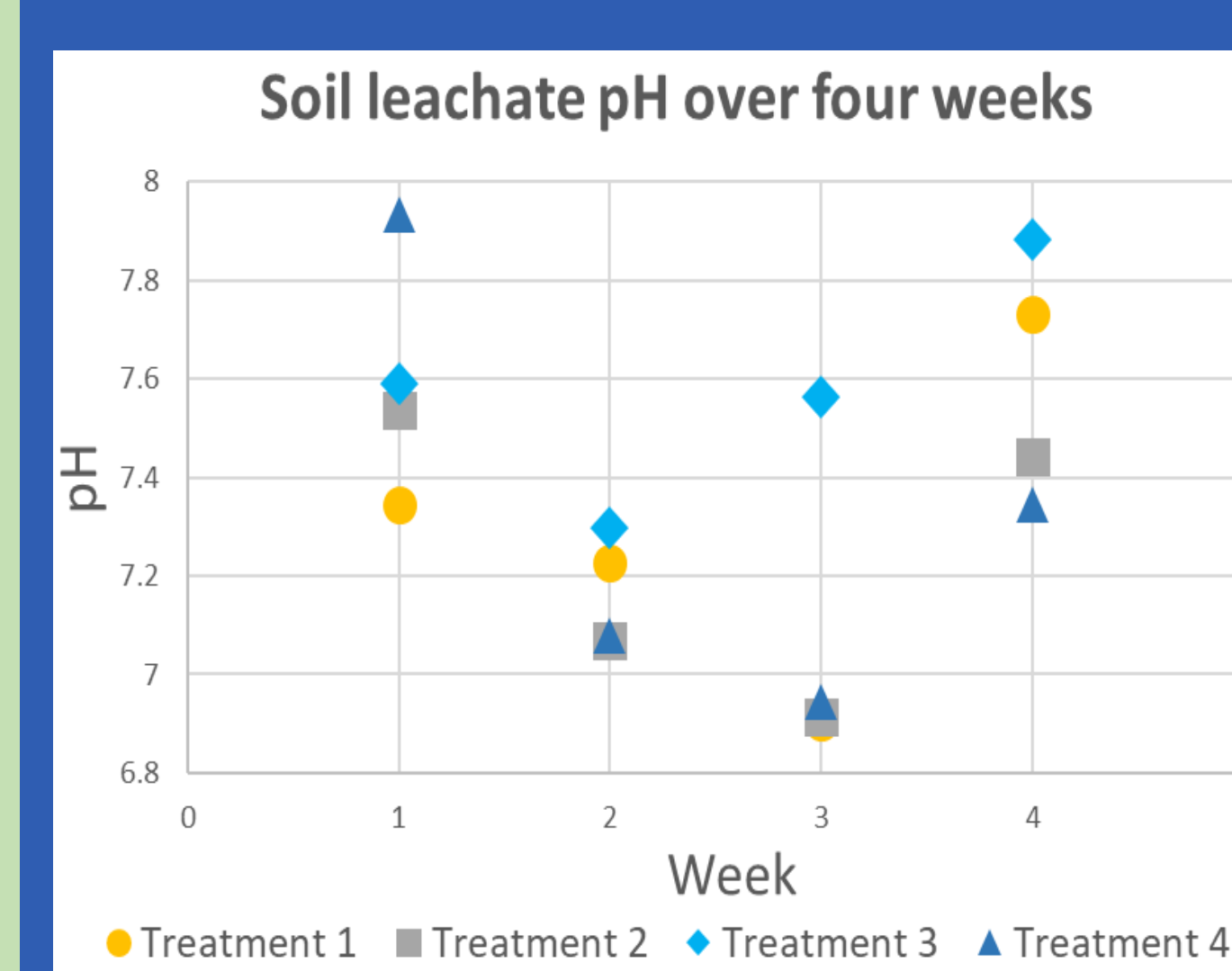


Figure 1: This graph shows the changes in soil leachate pH over four weeks for each of the treatment groups.

Treatment Group	Soil microbial respiration rate (g CO ₂ g ⁻¹ air-dry soil s ⁻¹)
1 ●	6.99 x 10 ⁻¹⁰
2 ■	8.39 x 10 ⁻¹⁰
3 ◆	9.76 x 10 ⁻¹⁰
4 ▲	7.47 x 10 ⁻¹⁰

Figure 2: Soil microbial respiration rates for each of the treatment groups. The CO₂ produced by respiration in moist soil is trapped in NaOH solution.

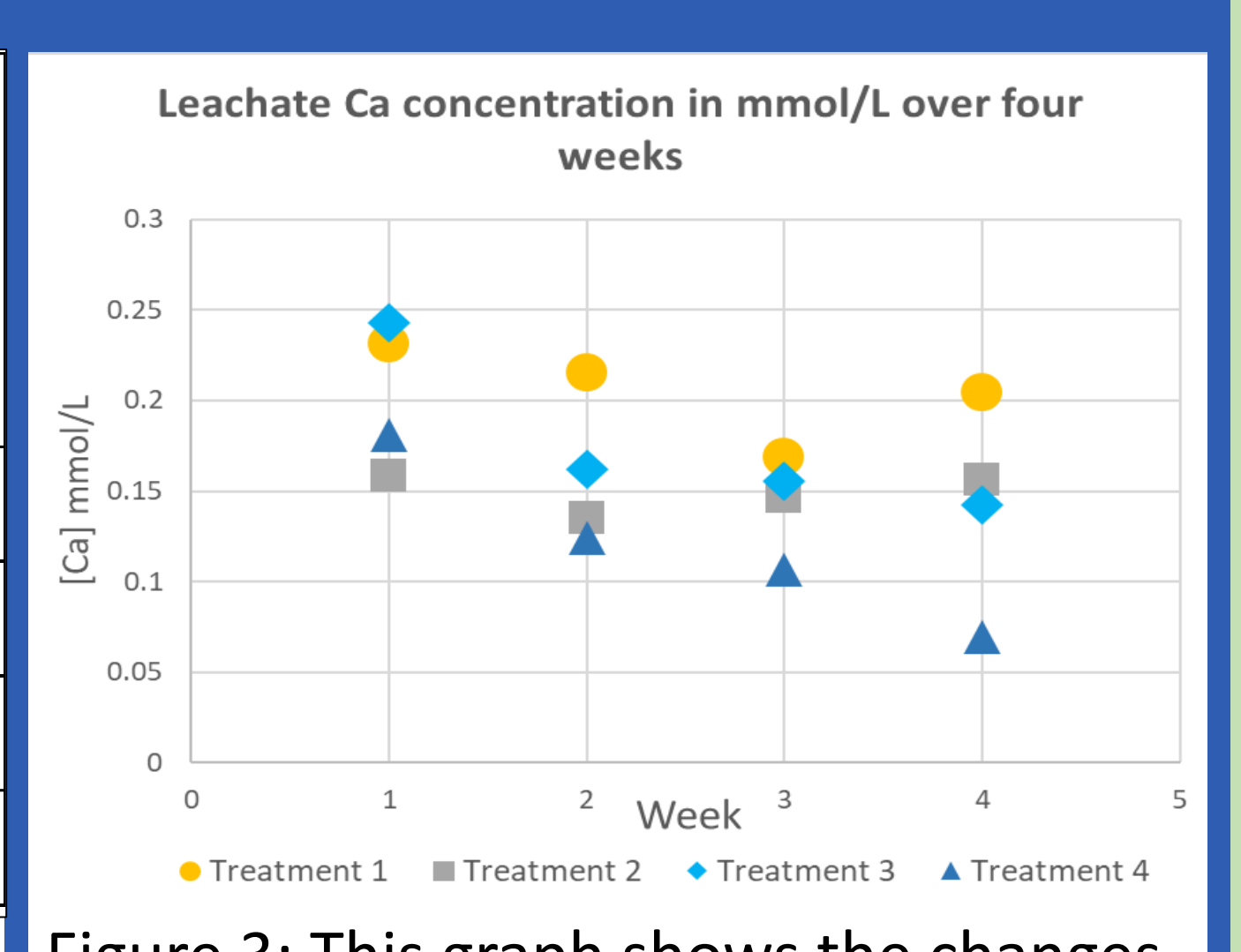


Figure 3: This graph shows the changes in soil leachate Ca concentration in mmol/L over four weeks for each of the treatment groups.

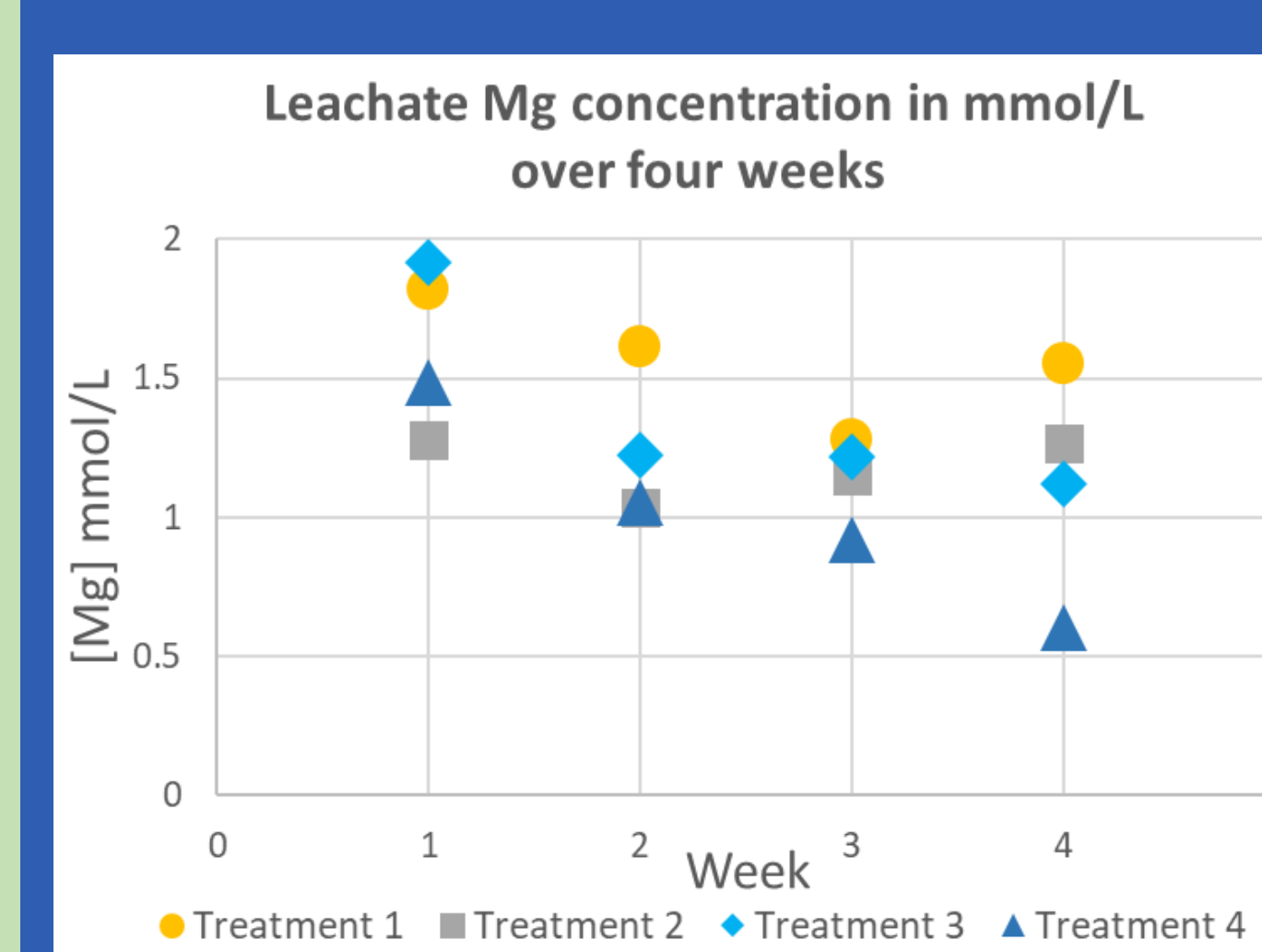


Figure 4: This graph shows the changes in soil leachate Mg concentration in mmol/L over four weeks for each of the treatment groups.

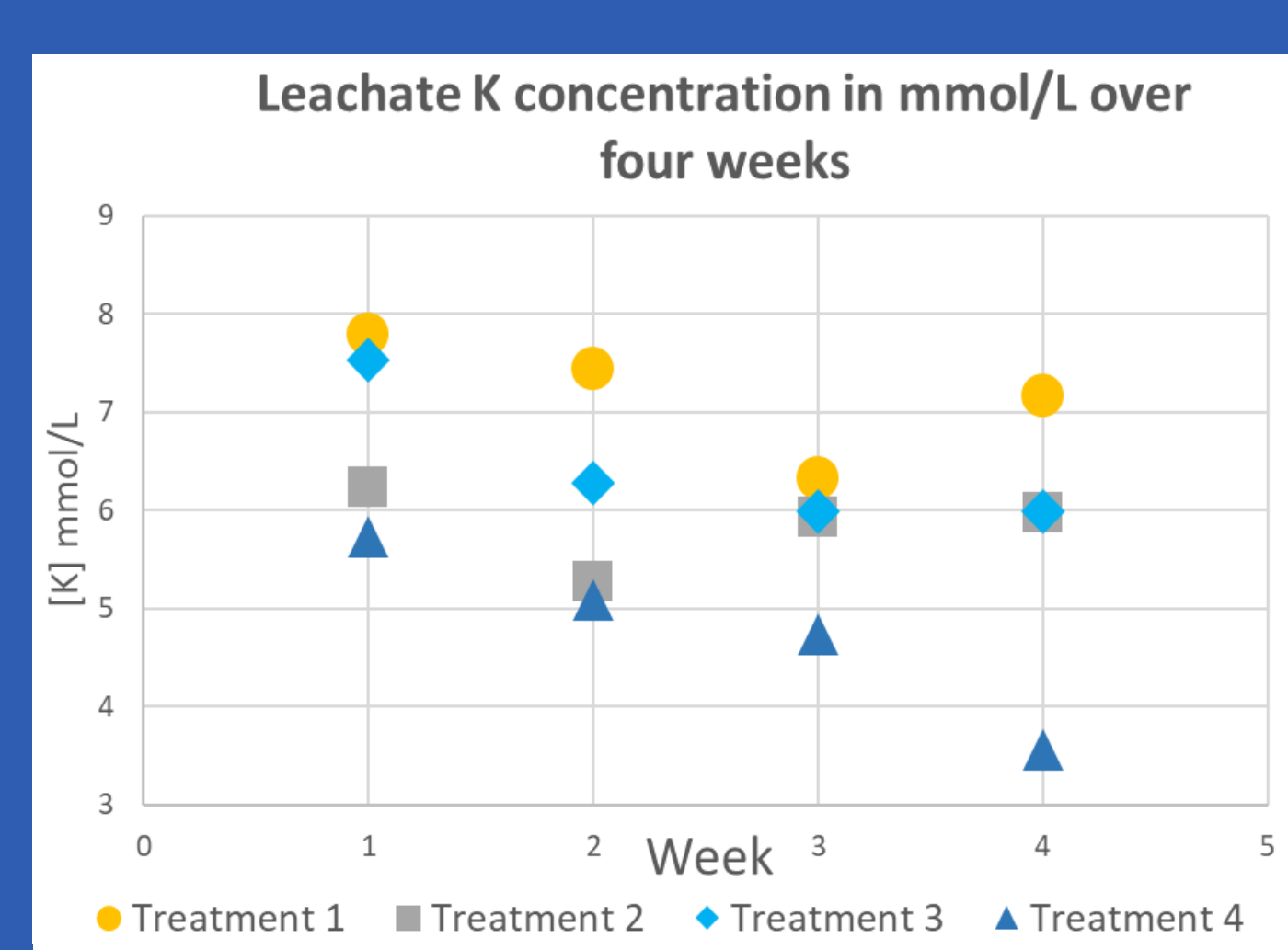


Figure 5: This graph shows the changes in soil leachate K concentration in mmol/L over four weeks for each of the treatment groups.

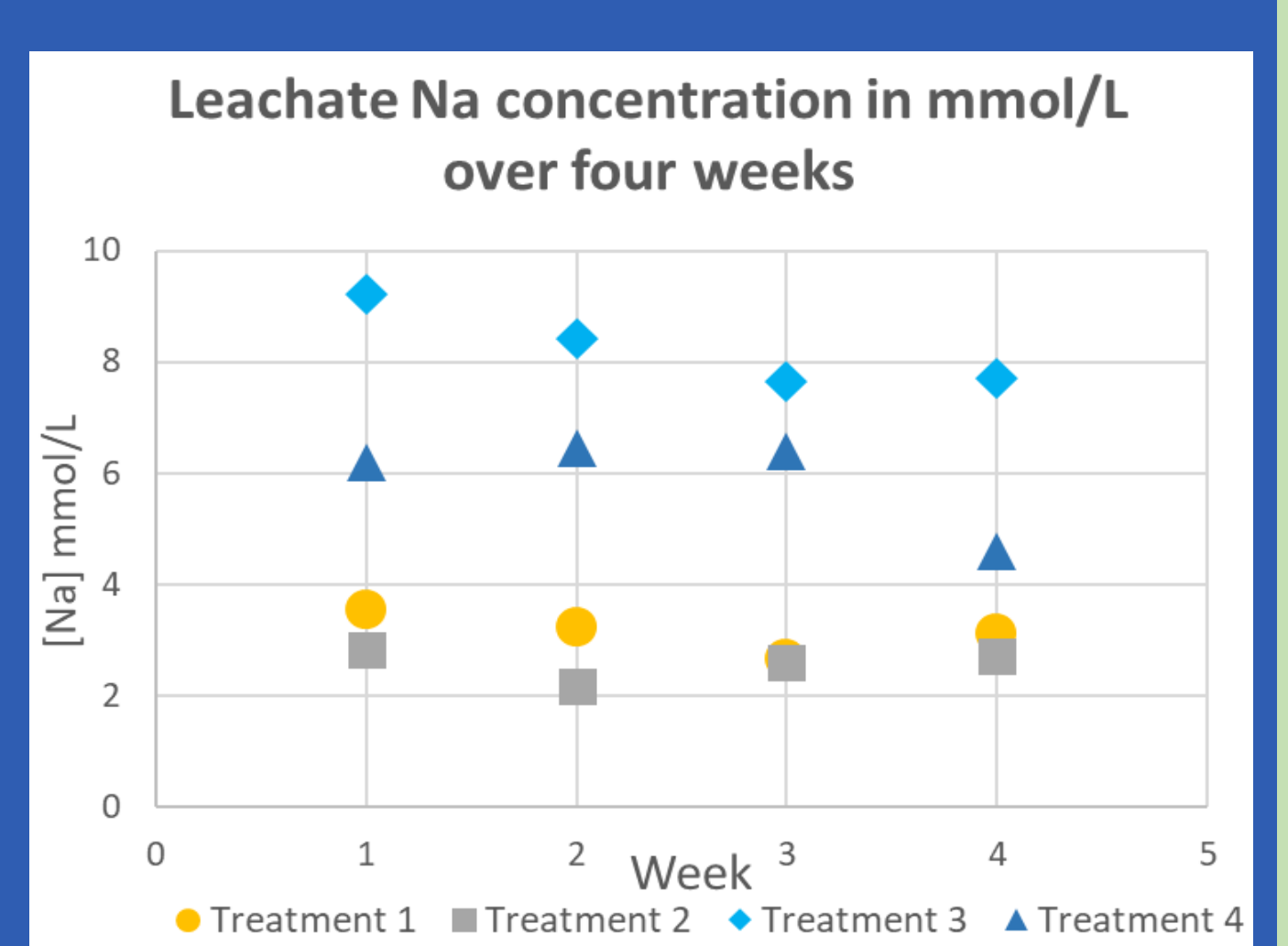


Figure 6: This graph shows the changes in soil leachate Na concentration in mmol/L over four weeks for each of the treatment groups.

DISCUSSION

Figure 1 shows there is no significant increase in soil leachate pH for groups treated with basalt compared to untreated groups. The small pH drop observed in groups 2 and 4 could be due to the plants excreting organic acids to balance charge when they take up positively charged ions from solution and or from excreting organic compounds which are acidic.

Figure 2 shows soil microbial respiration rates for each of the treatment groups. There is no significant difference in respiration rates between groups treated with basalt and or plants compared to untreated groups. More replicates should have been conducted to increase the accuracy. No plant growth was observed.

Figures 3, 4, 5, and 6 do not display an upward trend over time therefore do not support the hypothesis that leachate metal cation concentrations increase due to enhanced mineral weathering in soil groups treated with basalt. Further research over a longer period of time is needed.

