Urban soil enzyme activity restoration with Burger dirt

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Outline

- Introduction
- Methods and materials
- Results and discussions
- Conclusion

Soil enzyme activity

Indicator of soil quality (Vázquez et al. 2020)

Stable protein with catalyst function

Source

plant root residue

animal and microbes excretion

Vital in the nutrient cycle

Urbanization and soil enzyme

- Sensitive to pollutant
- Prone to food insecurity
- Low microbial and enzyme activity in acid and anthropogenic soil

Food waste issues

- Waste about 30-35% of total food production annually (UNSD 2020)
- Food for next meal by composting
- Accept animal based organic material composting method

Burger dirt

Highly versatile method

Anaerobic

Low emission of greenhouse gasses

Objective

- To determine the effect of soil enzyme activity change with assorted Burger dirt ratio and restoration period

Experimental design

- Completely random design

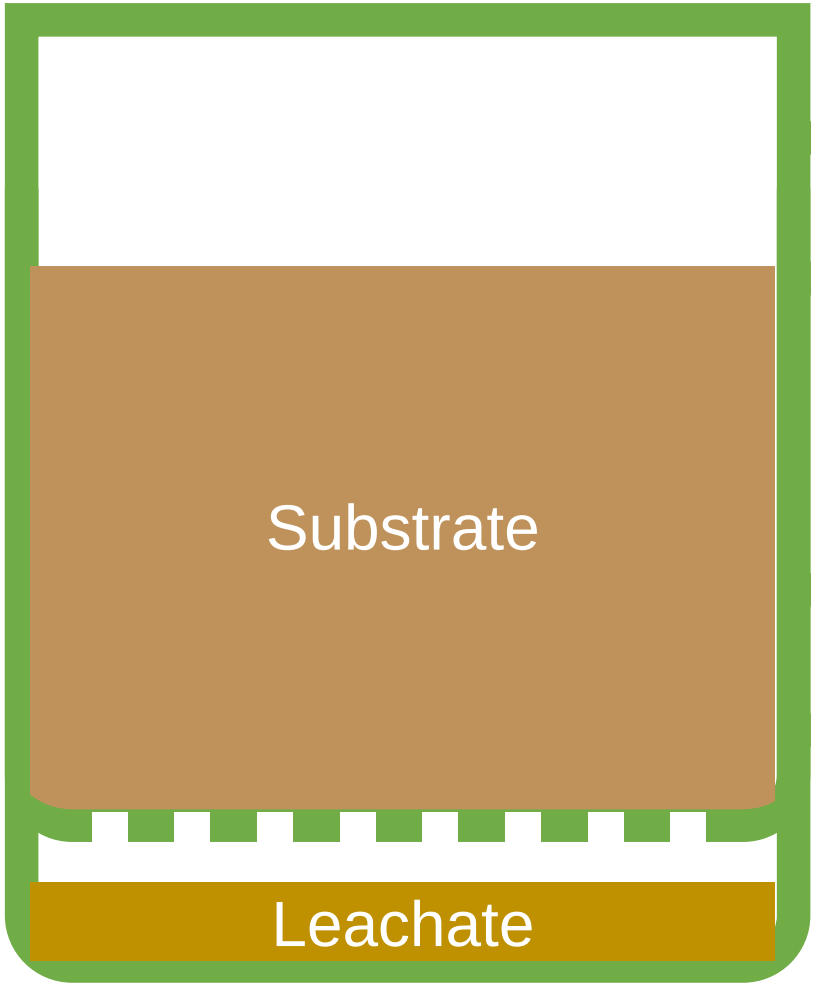
Treatments

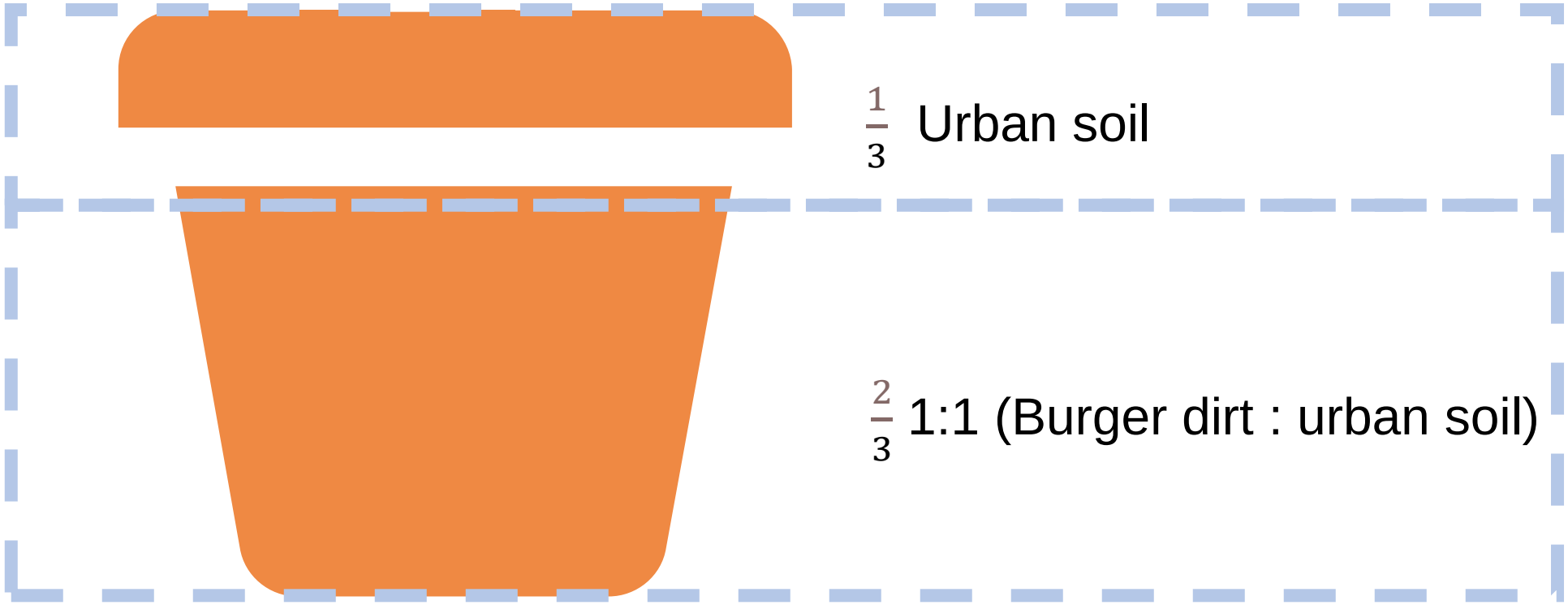
- Soil restoration periods (2, 4, 6, and 8 weeks)
- Ratio of soil to Burger dirt (1:1 and 1:2)

Burger dirt preparation

Fermented for 2 weeks

After 2 weeks





Restoration for 2, 4, 6, and 8 weeks

Soil physiochemical

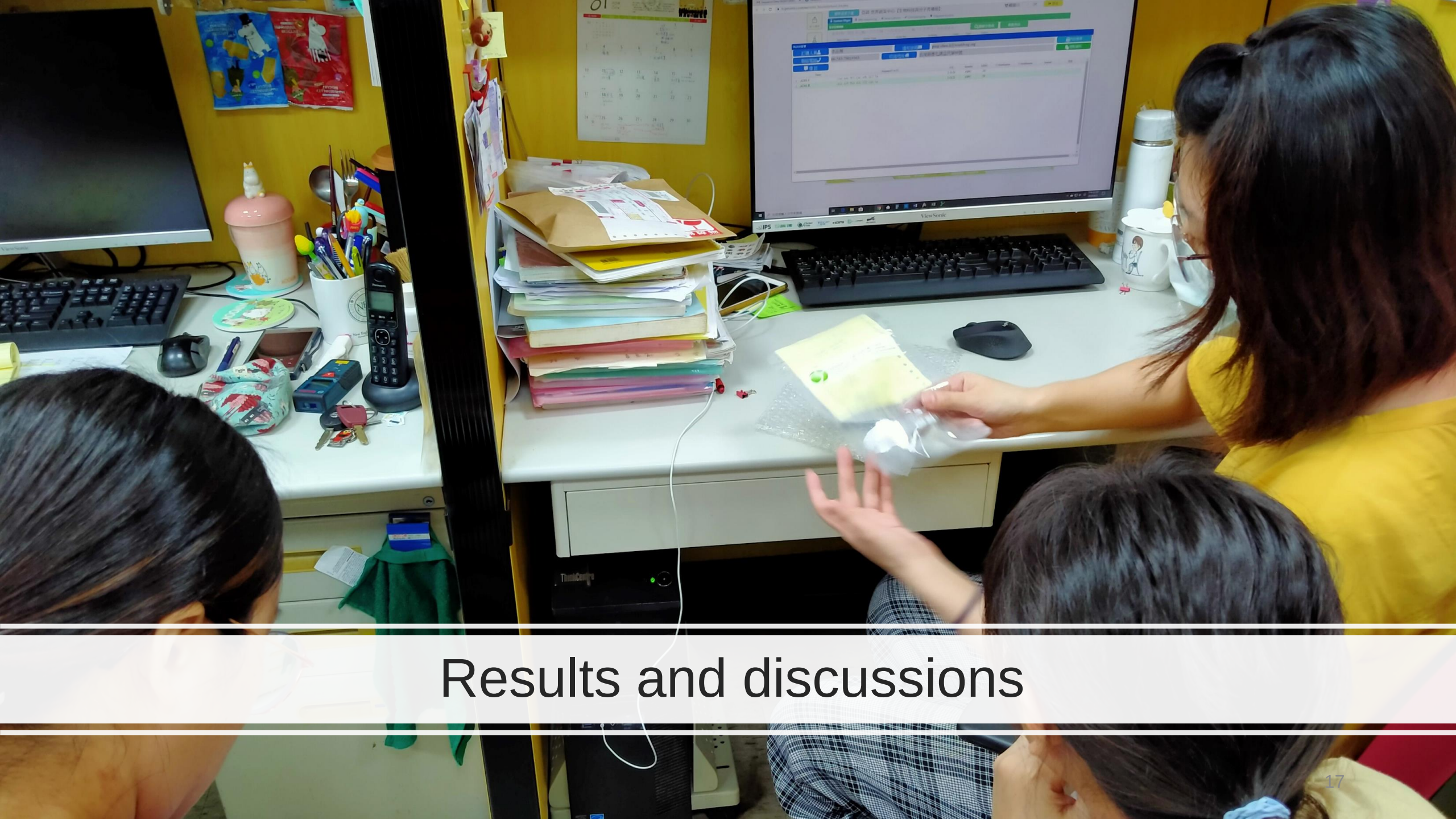
- Soil texture (Teh and Talib 2006)
- Soil pH
  - 1:2.5 soil to water extract (Xu et al. 2020)
- Soil moisture content
  - gravimetrically (Xu et al. 2020)

Soil enzyme activity

- Catalase activity
  - back-titrating residual H_2O_2 with $KMnO_4$ (Guan 1986)
- Urease activity
  - spectrophotometrically (Guan 1986)

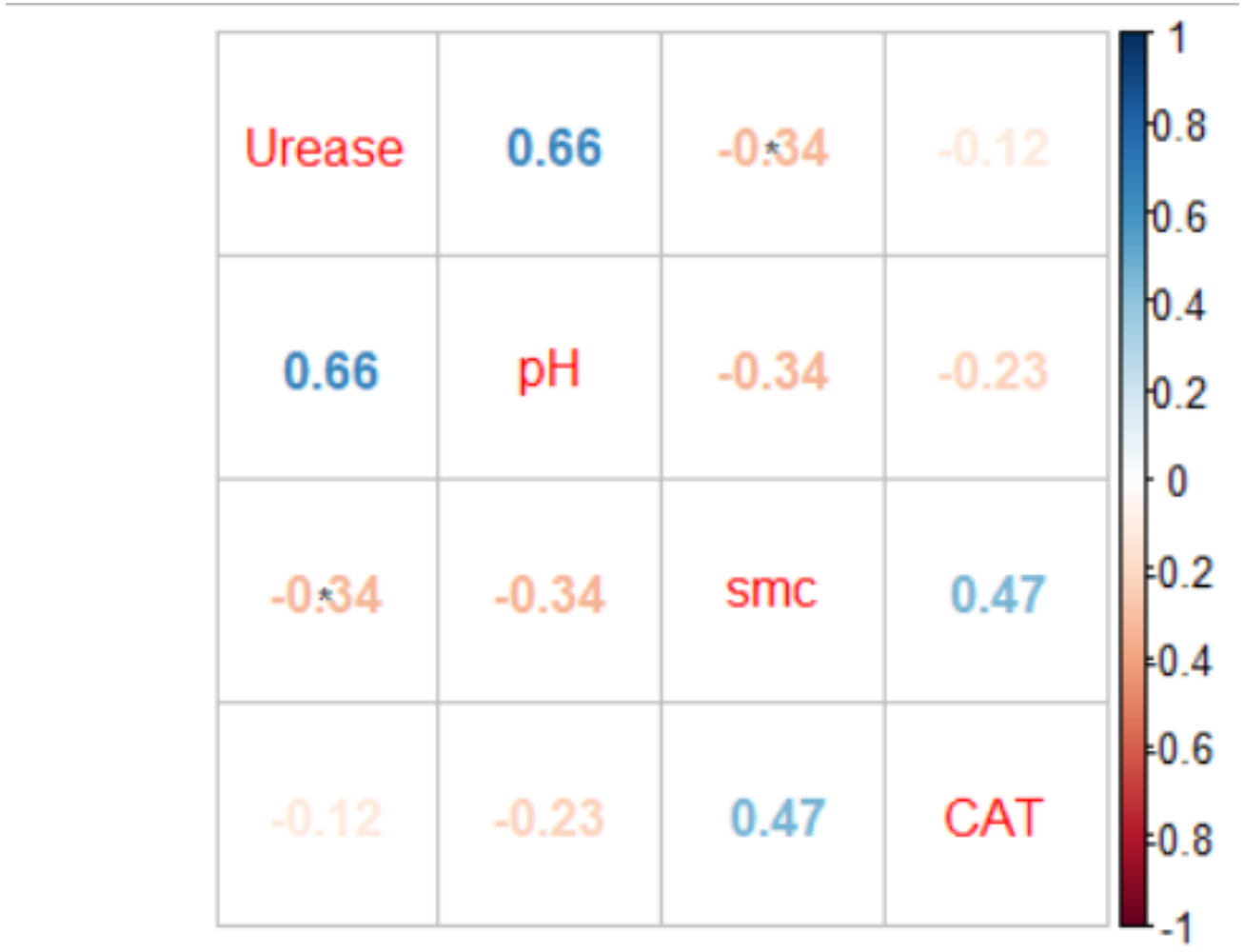
Statistical analysis

- Two-way analysis of variance (ANOVA)
- R statistic software
- DMRT ($p<0.05$)



Results and discussions

Figure Correlation of urease activity (urease), pH, soil moisture content (smc) and catalase activity (CAT).



Soil pH increased with time and amount of Burger dirt

- pH rose with the aerobic soil restoration (Smårs 2002)
- Drought condition increased the soil pH over time (Msimbira and Smith 2020)

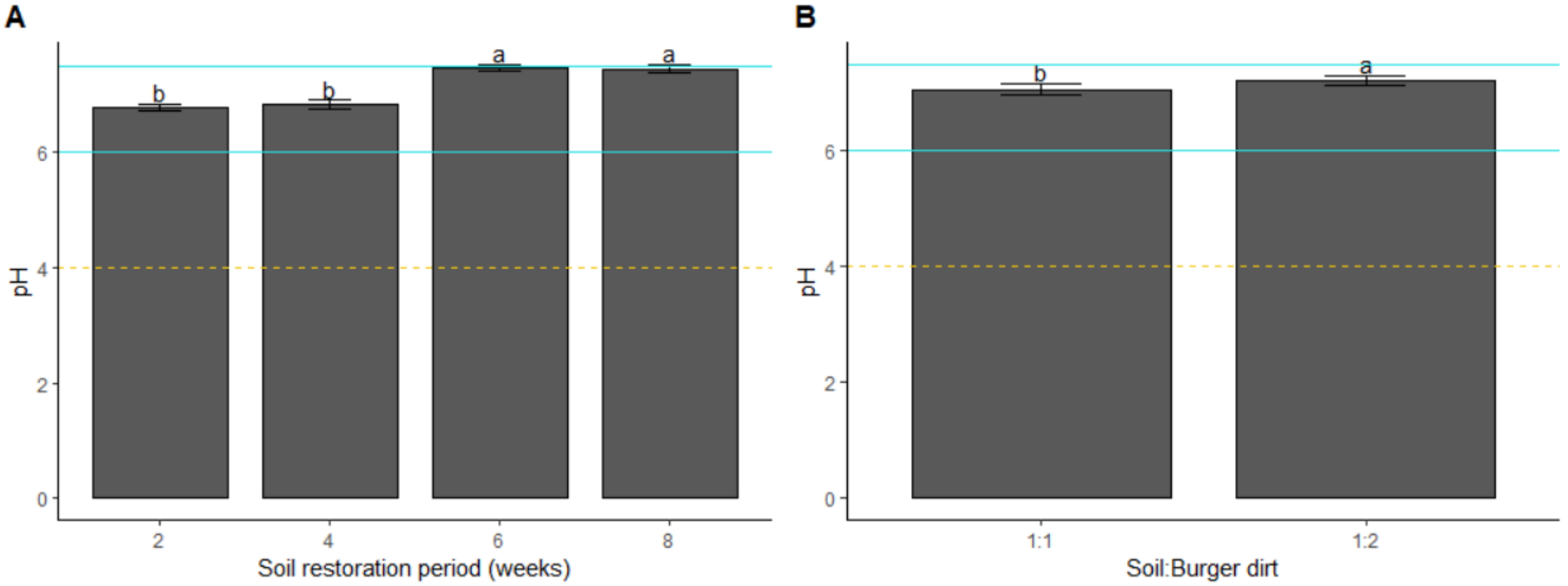


Figure Effect of (A) soil restoration period and (B) soil: Burger dirt ratio on pH. Means ± standard error with different letters is significantly different at P<0.05 using DMRT.
* “ – ”: recommended pH range (Whiting et al. 2015); “ - - - ”: pre-treated soil pH

Urease activity increased with restoration period

- Low ammonium is released in soil as the soil moisture content decreases and pH increases (Strock 2008)
- Urease activity high in dry season (Fan et al. 2020)

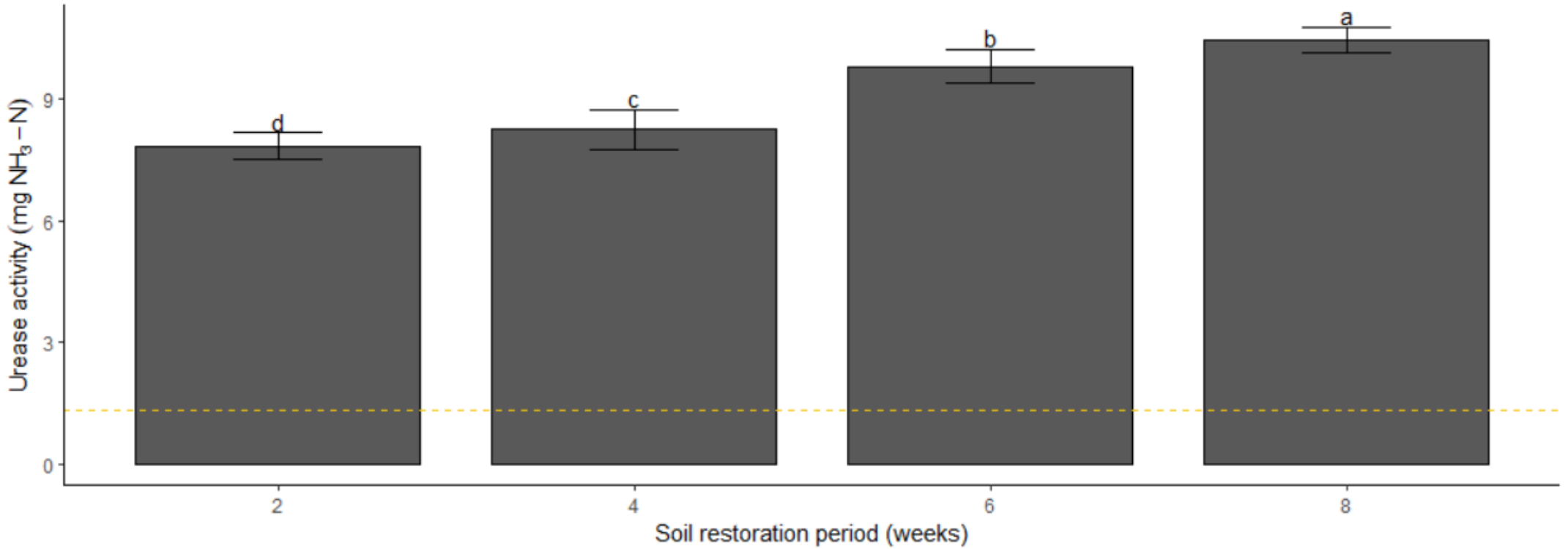


Figure Interaction effect of soil restoration period (weeks) on soil urease activity (mg NH_3-N). Means ± standard error with different letters is significantly different at P<0.05 using DMRT.

" - - - ": pre-treated soil urease activity

Soil moisture content

- Low moisture content = low actual transpiration rate (Denmead and Shaw 1962)
- Catalase activity increased with soil moisture content (Gömöryová et al. 2006, Borowik and Wyszkowska 2016)
- 20 % of soil moisture content showed higher enzyme activity (Borowik and Wyszkowska 2016)

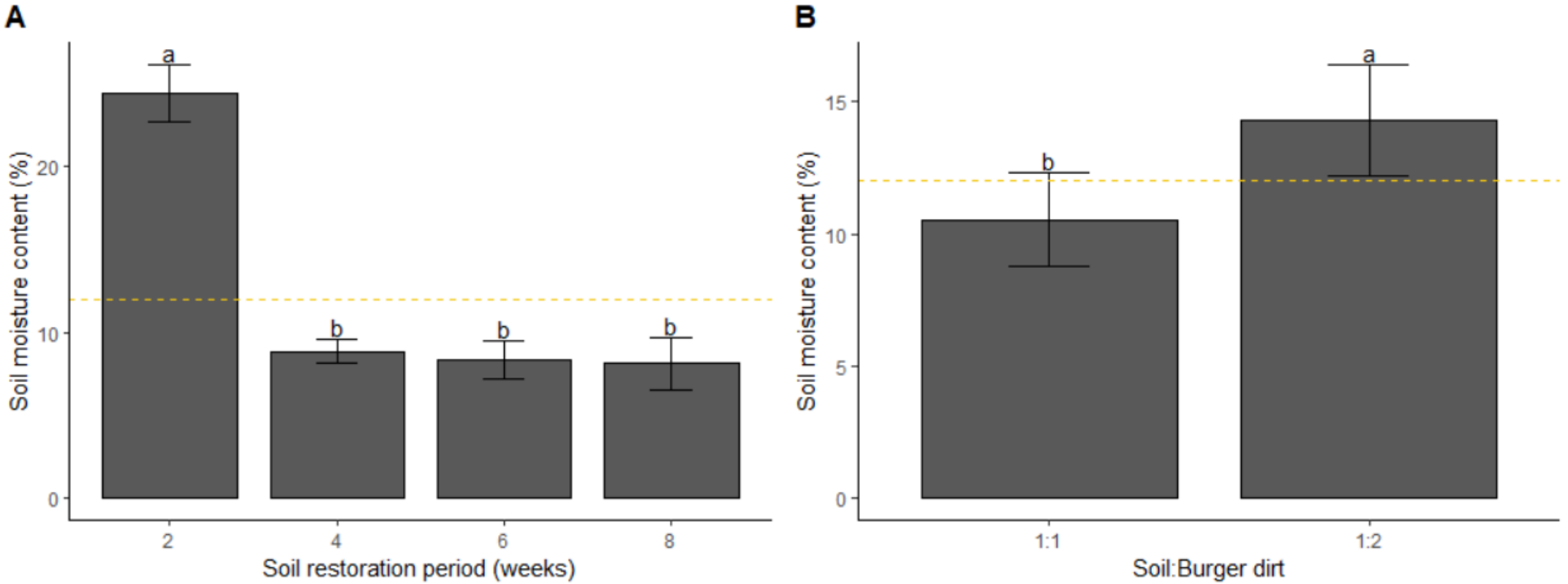


Figure Effect of (A) soil restoration period and (B) soil:Burger dirt ratio on soil moisture content. Means ± standard error with different letters is significantly different at P<0.05 using DMRT.

* “ - - - ”: pre-treated soil moisture content (%)

Catalase activity declined with time but increased with amount of Burger dirt

- Soil catalase increased under well aerated soil (Brzezińska et al. 2005)
- Soil catalase activity was significantly low in dry season compared to rainy season (Fan et al. 2020)

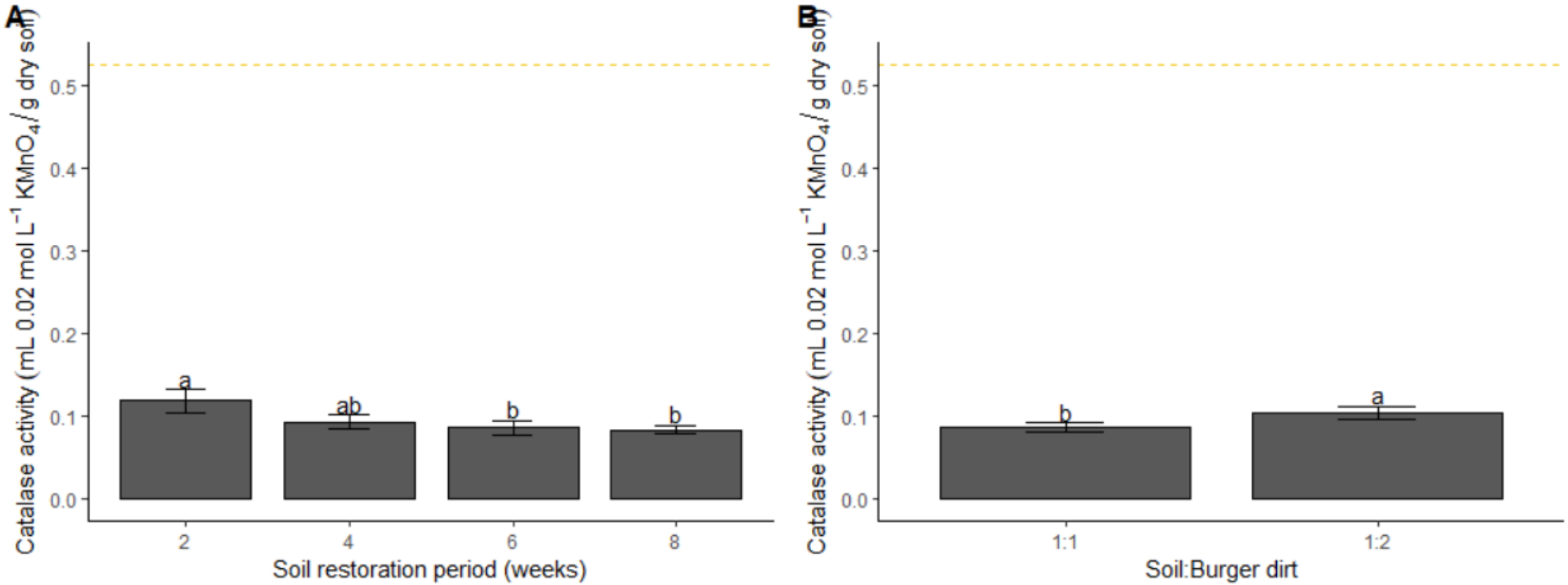


Figure Effect of (A) ratio of soil to Burger dirt (1:1 and 1:2) and (B) soil restoration period (weeks) on soil catalase activity (mL 0.02 mol L^{-1} $KMnO_4$ per g soil). Means ± standard error with different letters is significantly different at P<0.05 using DMRT.

* " - - - ": pre-treated soil catalase activity

Conclusion

- Burger dirt shows an ameliorative effect as it was able to increase the soil pH
- 700 times urease activity improvement
- Soil moisture content and catalase activity decreased simultaneously
- 2 weeks of soil restoration period with 1:2 soil to Burger dirt ratio is recommended

Thank you