Effect of Fine Cement Sand and Zeolite Amendment on Rye (*Secale cereal*) Biomass Accumulation in Two Local Soils

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Introduction

- Both rock dusts and zeolites have been shown to improve crop yields when applied to certain soils
- Rock Dusts
  - Derived from silicates, feldspars, amphibolite and other rocks can provide plant nutrients, including calcium, potassium, iron, phosphorous and magnesium
  - Release minerals at various rates, depending on weathering, soil type, soil microbiology, and particle size
  - Applied to agricultural soils to improve cation exchange capacity and neutralize acidity
  - Commonly used in biodynamic preparations
- Zeolites
  - Microporous, crystalline aluminosilicates
  - Sorb cations including ammonium (NH_4^+)
  - Applied to agricultural soils to neutralize acidity; increase aeration; increase cation exchange capacity; slow the release of ammonium, nitrogen, and potassium; reduce odours; and improve nitrogen use efficiency.
- Regional sources
  - Fine cement sand (rock dust) is available from the Orca Quarry, near Port McNeill
  - Clinopitilite zeolite is available from the Canadian Zeolite quarries near Princeton

- Winter rye (*Secale cereal*)
  - Frost resistant, allelopathic grain, closely related to barley and wheat
  - Commonly planted in fall as a cover crop to prevent winter soil erosion, reduce weediness, scavenge and retain nutrients, break hard pan, and build soil organic matter content

Objective

Evaluate winter rye response to a range of rock dust and zeolite application rates in two different soils from farms managed by KPU. Test for interactions between amendment, application rate, and soil type.

Materials and Methods

- Study design: Completely randomized factorial with three replicates
- Experimental factors:
  - Two soil amendments: Orca fine cement sand or Canadian zeolite
  - Five application rates per amendment:
    - Rock dust applied at 0, 48, 96, 192 or 288 g/L
    - Zeolite applied at 0, 274, 547, 1094 or 1641 g/L
  - Two soil types:
    - Low (~1%) organic matter sandy clay loam from the Garden City Lands
    - High (~11%) organic matter silty clay loam from the KPU Orchard in south Richmond
- Experimental units: 25 L plant pots
  - 2 amendments x 5 rates x 2 soils x 3 reps = 60 pots
  - Pots filled with soil, then amended in the top 10 cm to mimic farm application
  - Rye seeded in 3 clumps of 4 seeds on Sept. 11, 2018
  - Pots randomized in a single line along a south-facing terrace at the KPU Richmond campus
  - Pots weeded and monitored for two months
- All plant matter harvested on Nov. 6, 2018
  - Washed to remove soil
  - Oven dried for at 75°C until weight stabilized (72 h)
  - Dry biomass weighed
- Data analyzed by general linear model in R

Results

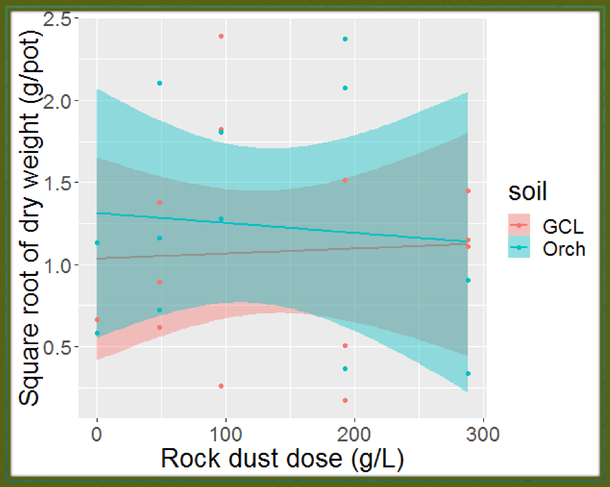

Fig 1. Square root of rye dry weight over a range of rock dust amendment rates in organic silty clay loam soil from the KPU Orchard (blue) or sandy clay loam from the Garden City Lands (red). Shaded areas show 95% confidence interval around lines.

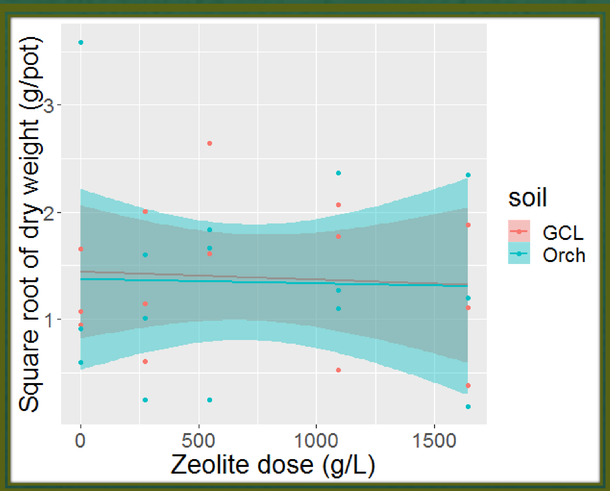

Fig 2. Square root f rye dry weight over a range of zeolite amendment rates in organic silty clay loam soil from the KPU Orchard (blue) or sandy clay loam from the Garden City Lands (red). Shaded areas show 95% confidence interval around lines.

Conclusions

None of the experimental factors had any detectable effect on rye biomass production. No interactions were found between the factors tested.

Both rock dust and zeolite have been previously reported to neutralize acid soils and increase soil cation exchange capacity. The tested soils were not acidic, and had high cation exchange capacity due to their clay content, so the amendments may not have offered benefits.

Soil amendment was expected to have the greatest impact in the soil from the Garden City Lands because it had a much lower organic matter and nitrogen content than the Orchard soil. Even without amendment, rye biomass production did not differ between the two soils, This suggests that winter rye is tolerant of adverse conditions, and may not be a suitable test crop.

Further studies are needed to evaluate possible benefits of soil amendment with rock dust or zeolite.

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