The Use of Clinoptilolite Zeolite as a Soil Amendment to Reduce Evaporation Rates in Sandy Soils

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Introduction

Conservation of water is crucial in arid environments where water is scarce. Sandy soils of the southwestern United States ,where rainfall is less than 9 inches/year, are prone to high evaporation rates due to: their larger pore space, thermal properties of soil minerals mixed with water, and prolonged drought (Repetto et al. 2012). This study assessed the use of clinoptilolite zeolite (CZ) as an amendment to sandy soils in order to reduce evaporation depletion. The hypothesis is that CZ when added to soil will reduce evaporation because of its crystal lattice structure and its ability to hold high water content (Breck et al. 1974).

Research Inquiries

1. Does the use of clinoptilolite zeolite as a soil amendment reduce evaporation rates?

2. Which ratio of clinoptilolite zeolite yields the lowest rate of evaporation?

Methodology

Clinoptilolite zeolite was thoroughly mixed with sandy soil in a 12 five-gallon buckets at the following ratios:

- 20% zeolite and 80% soil - 3 buckets
- 40% zeolite and 60% soil - 3 buckets
- 60% zeolite and 40% soil - 3 buckets
- 100% zeolite – 1 bucket (control)
- 0% zeolite and 100% soil – 2 buckets (control)

Buckets were saturated, drained to field capacity, and placed in direct sunlight. Buckets were weighed daily to calculate average evaporation loss.

Soil Temperature Profile

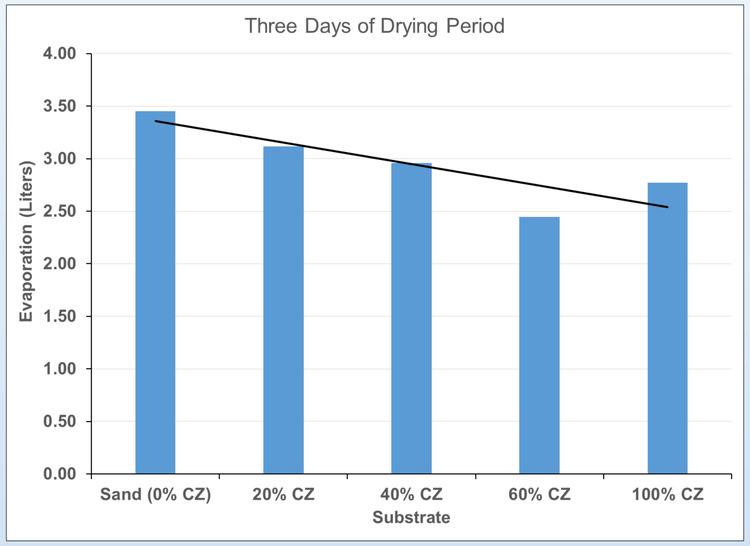
- collected daily at ten minute intervals
- Taken at soil surface (1 in.) and sub-surface (7.25 in)
- CR1000x datalogger, AM32/16A Multiplexer, thermocouple wires, solar battery

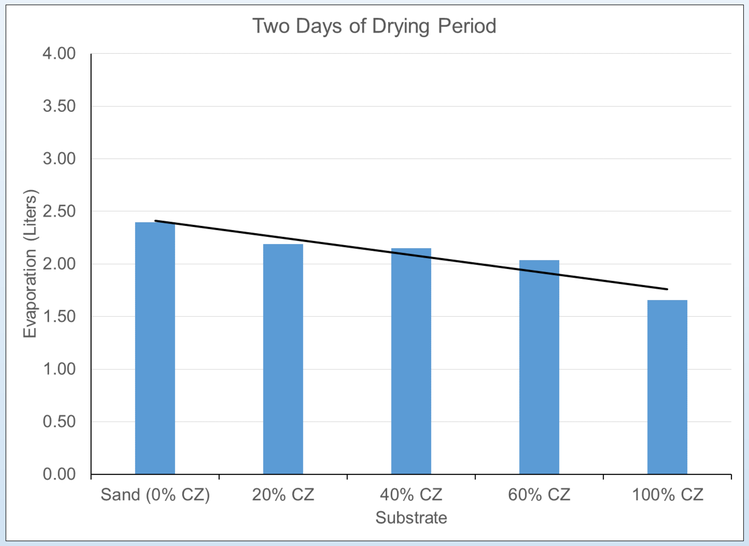
Volumetric Water Content

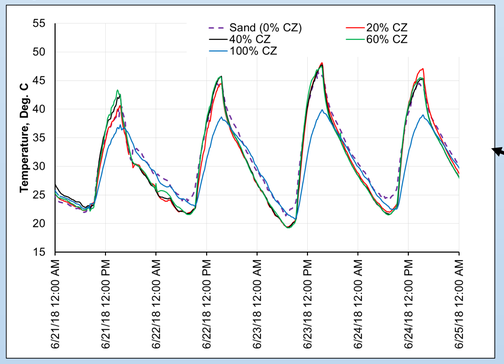
- collected daily
- HydrosenseII water reflectometer used
- Once at VWC of 6 ≤ buckets re-saturated

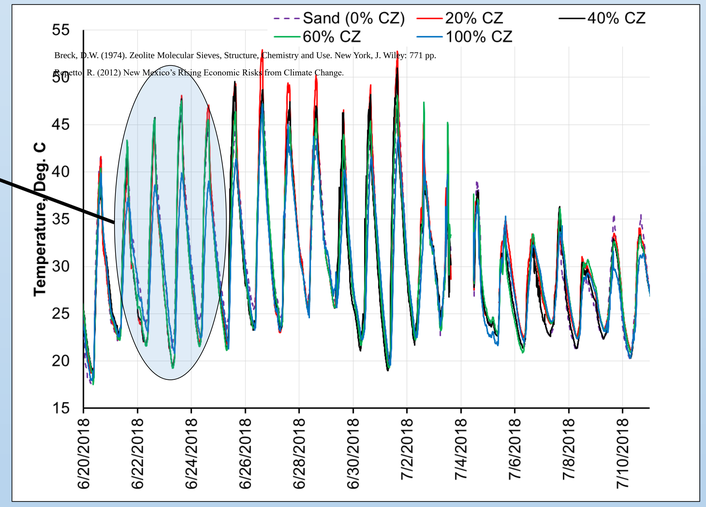
Results

Evaporation rates varied from one day to another due to fluctuations in ambient temperatures. Total evaporation during three and two days are shown on right respectively. The results show that evaporation depletion decreased with an increase in zeolite percentage ratio in sandy soil. A decrease in evaporation depletion for different CZ-Sand ratios was inconclusive due to minimum number of drying cycles (only two cycles).









Temperature of the substrates followed diurnal ambient temperatures. A significant difference in temperature was observed between sand (0% CZ) and CZ (100%) reaching up to 9 ^{o}C. No significant difference in temperature was observed for other mixtures

Conclusion

- Addition of CZ to soil reduced evaporation rates
- Further testing needed to determine best ratio
- 100% CZ remained cooler than 0% CZ

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